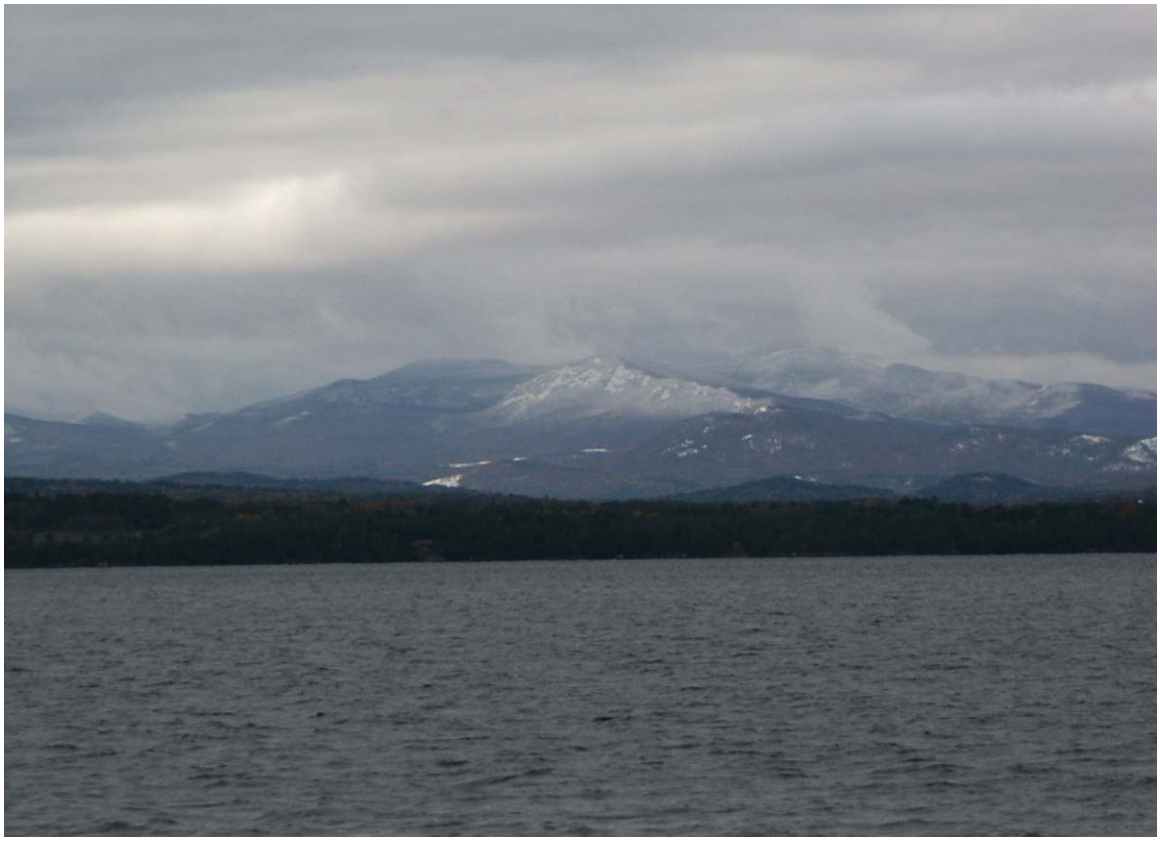
Progress in Establishing and Implementing the Total Maximum Daily Load (TMDL) Plan for Lake Champlain



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Contents

Cover photograph by Angela Shambaugh, Vermont Agency of Natural Resources

Executive Summary

Act 43 asks a number of important questions related to the need to set priorities for improving water quality in Lake Champlain. Specifically, Act 43 directed the Agency of Natural Resources (ANR) to:

- Assess the implementation plan for the Lake Champlain Phosphorus TMDL, evaluate its efficacy, and make any recommendations for amending the implementation plan or reopening the TMDL; and,
- Analyze the feasibility and cost of implementing additional phosphorus treatment processes at wastewater treatment facilities in the Lake Champlain basin.

ANR both recognizes and takes seriously its obligation under the federal Clean Water Act to ensure attainment of water quality standards in all waters of the state. Technical and financial resources, nonetheless, are finite and therefore ANR must set priorities. With this in mind, ANR offers the following:

1. **Reopening the TMDL would require an investment of significant resources that would otherwise be dedicated to developing and implementing projects to improve water quality in Lake Champlain.**
   Our state's water quality standards and the phosphorus loading targets currently in the TMDL provide clear direction – substantial reductions are needed in the phosphorus load being delivered to Lake Champlain. As we progress toward the water quality targets, it may become necessary to evaluate whether additional load reductions are needed to achieve the in-lake standards.

2. **The cost of implementing additional phosphorus reductions at wastewater treatment facilities is substantial and must be considered carefully.**
   Over the past 30 years, Vermont's policies have reduced wastewater phosphorus loads to Lake Champlain by 90%. Completely eliminating phosphorus from wastewater discharges is an unrealistic option and would provide only a small increment of the load reduction needed to achieve water quality endpoints established in the TMDL. Continued focus on controlling phosphorus in wastewater discharges only diverts funding and other resources from essential efforts to comprehensively address non-point source pollution.

3. **Non-point sources are now responsible for more than 90% of the phosphorus load being delivered to Lake Champlain and must be the focus of water quality programs going forward.**
   Meaningful water quality improvements in the future will only occur by addressing non-point source pollution. Although the control of non-point source pollution presents significant technical challenges both in the Lake Champlain basin and nationwide, efforts must target the biggest sources - not just those which are easiest regulate.

4. **Amending the TMDL implementation plan does not require reopening the TMDL.**
   In complex systems such as Lake Champlain, we need to act in order to learn; a "living" implementation plan is central to the process of action. ANR has continuously reevaluated, modified, and adapted the approach originally laid out in the implementation section of the Lake Champlain TMDL over the past four years, applying what has been learned from past

experience. Most recently, through work of the Clean and Clear task force, ANR undertook a comprehensive and public process to evaluate progress in implementing the TMDL and consider changes to the implementation plan that are needed going forward.

5. **The quality and the volume of work produced by the Agencies of Natural Resources and Agriculture, Food and Markets (AAFM) as a result of the Clean and Clear program is extensive.**
   Through Clean and Clear, ANR and AAFM have significantly expanded and enhanced implementation of broad-based water quality improvement programs, especially throughout the Lake Champlain basin, including: hydrology-based stormwater management, agricultural water quality regulation, river management, wastewater treatment, watershed planning, wetland restoration, and local road improvement. These programs support on-the-ground efforts needed to achieve state water quality objectives for Lake Champlain.

Through the Clean and Clear program, ANR and AAFM, in cooperation with state, federal, and local partners, have made significant efforts and progress in implementing practices and programs to reduce the phosphorus load being delivered to Lake Champlain that otherwise would not have been undertaken. Much more work remains in order to achieve the water quality goals established in the Lake Champlain Phosphorus TMDL. **The current TMDL, coupled with the implementation plan's evolving strategy to achieve water quality standards, provides a sound and appropriate framework for the on-going implementation of phosphorus control measures.** ANR and AAFM continue to work aggressively to implement the necessary practices and programs needed to achieve water quality standards and the goals of Clean and Clear.

Introduction and Background

During the 2007 session, the Vermont Legislature passed Act 43, relating to stormwater management and implementation of the Lake Champlain Phosphorus TMDL (total maximum daily load). This act requested a report detailing a series of analyses and responses related to progress in meeting pollutant load reductions established in the Lake Champlain TMDL by January 15, 2008. Specifically, the report was to include:

- *An assessment of the implementation plan for the TMDL based on available data, including an evaluation of the efficacy of the implementation plan;*
- *Recommendations, if any, for amending the implementation plan or reopening [the] TMDL;*
- *An analysis and summary of the existing phosphorus treatment practices at each wastewater treatment facility in the Lake Champlain basin;*
- *An analysis of each wastewater treatment facility in the Lake Champlain basin in order to determine the feasibility of each facility reducing the amount of phosphorus it discharges to state waters;*
- *An estimate of the capital cost to each wastewater treatment facility in the Lake Champlain basin of implementing the phosphorus reduction treatment processes;*
- *Recommended incentives that would encourage wastewater treatment facilities in the Lake Champlain basin to reduce voluntarily phosphorus discharges.*

In addition, Act 43 required that "*Prior to issuing the reports required under this section, the agency of natural resources shall hold a public hearing in the Lake Champlain watershed...*". In response, ANR conducted a series of three public hearings in December 2007. A list of attendees is included as Appendix A, and a copy of the meeting presentation materials is available at the Clean and Clear website:
http://www.anr.state.vt.us/cleanandclear/news/Act43-121007.pdf

Although Act 43 also requested "*An assessment of the hydrologic targets of the TMDL based on available data, including an evaluation of the adequacy of the hydrologic targets of the TMDL,*" this request pertains to the stormwater management report that will be delivered in January 2009, and therefore is not addressed herein.

The Lake Champlain Phosphorus TMDL[1] was developed to quantify phosphorus inputs to the lake and estimate the maximum allowable phosphorus loads that could be assimilated while achieving water quality standards. The TMDL was developed and submitted jointly by Vermont and New York to the U.S. Environmental Protection Agency (EPA) in 2002 following an extensive public participation process in each state.

The Lake Champlain Phosphorus TMDL built upon a sequence of studies, plans, and agreements developed during the preceding ten years. The States of Vermont and New York and the Province of Quebec signed a water quality agreement in 1993[2] endorsing a consistent set of in-lake phosphorus concentration criteria to serve as mutual lake-management goals. The 1996

[1] http://www.anr.state.vt.us/cleanandclear/plan.htm
[2] http://www.anr.state.vt.us/dec/waterq/lakes/docs/lp_phostaskforce93.pdf

comprehensive basin plan titled "*Opportunities for Action*" developed by the Lake Champlain Basin Program[3] included a negotiated division of responsibility between Vermont and New York for achieving the necessary phosphorus reductions. A whole-lake phosphorus budget and mass balance modeling study completed by Vermont and New York in 1997[4] produced a comprehensive measurement of phosphorus loading to the lake and projected necessary loading reductions for the various lake segment watersheds.

A fundamental underpinning of the TMDL approach is that it comprehensively assigns responsibility for load reductions among the various sources in a fair manner that is likely to achieve water quality standards. The TMDL then allocates the allowable loads among various sources such as discharges from wastewater treatment facilities and developed land and runoff from agricultural and forested land. The Lake Champlain TMDL established a target phosphorus load for the lake of 427.1 metric tons per year (mt/yr), or slightly more than 940,000 pounds. Of this, 268.4 mt/yr was allocated to Vermont, with the remaining load assigned to New York (119.8 mt/yr) and Quebec (38.9 mt/yr). A water quality agreement between Vermont and Quebec was signed in 2002[5] to define specific responsibilities for the Missisquoi Bay watershed.

In order to reach its target phosphorus load, Vermont proposed to limit its contributions from wastewater sources to an aggregate maximum of 55.8 mt/yr, representing a cap that is less than half of the 121.1 mt/yr load actually discharged by these facilities during 1991. The TMDL required Vermont nonpoint source loads (including loads from developed, agricultural, and forested land) to be reduced by 80.5 mt/yr from the 1991 baseline level of 293.1 mt/yr (27% reduction). Within these total load allocations, the TMDL established individual allocations for each sub-watershed in the Lake Champlain basin. Any successful effort to implement the TMDL and achieve water quality standards will require a strategic combination of point and non-point source control measures.

[3] http://www.lcbp.org/impofa.htm
[4] http://www.anr.state.vt.us/dec/waterq/lakes/docs/lp_lcdfs-finalreport.pdf
[5] http://www.lcbp.org/missbay.htm

Assessment of the Implementation Plan for the Lake Champlain Phosphorus TMDL

The Lake Champlain Phosphorus TMDL included a Vermont implementation plan describing specific action items and funding projected to accomplish the necessary phosphorus load reductions. Vermont's implementation plan was developed by professional staff specialists working in each relevant program area within ANR and AAFM. The TMDL implementation plan has served as the framework for the Clean and Clear Action Plan, which was put in place in 2004 as a response to severe algae blooms in parts of Lake Champlain, by guiding annual funding requests, staffing levels, and program priorities for the past four years. The Clean and Clear program provided a major enhancement of resources available to a wide variety of phosphorus reduction efforts conducted by state agencies and many partner organizations.

Section 4(a)(1) of Act 43 required that this report include "*an assessment of the implementation plan for the TMDL based on available data, including an evaluation of the efficacy of the implementation plan.*" This requirement will be addressed by providing: (1) a brief summary of the status of each action item listed in the Lake Champlain Phosphorus TMDL implementation plan; and (2) an annual report on activities and measures of progress for each program supported by the Clean and Clear Action Plan.

TMDL Implementation Plan Status

The status of each of the original TMDL action items is described briefly in Appendix B, Table B-1. Of the 55 actions items identified in the TMDL implementation plan, 47 are in progress (some with changes in scope), five have been completed, and three have seen no action. In general, the projects conducted as part of the Clean and Clear program have been highly consistent with the original implementation plan in the Lake Champlain TMDL. It is important to note that, moving forward, many of these actions will require sustained efforts over many years in order to fully accomplish the program purposes and goals.

For example, the TMDL implementation plan calls for ANR to "*conduct stream geomorphic assessments*." To date, initial assessments have been completed for more than 5,100 miles of streams and rivers using orthophotos, topographic maps, geographic information systems (GIS), and quick observation surveys. Further, more quantitative and qualitative assessments have been completed for 980 river miles through on-the-ground observations. The collection of additional assessment data is now being balanced with the design and implementation of protection and restoration projects identified as part of the river corridor planning process that follows each assessment. ANR estimates that by 2010 initial assessments will have been completed statewide.

Similarly, the TMDL implementation plan calls for AAFM to "*accelerate the establishment and protection of riparian buffers on agricultural land*." To date, the Conservation Reserve Enhancement Program (CREP) has enrolled more than 1,700 acres of stream and river corridor in the Lake Champlain basin. Further, AAFM released the Vermont Agricultural Buffer Program in 2007 which provides incentives for installing harvestable filter strips and grassed waterways – creating additional options for farmers to use in protecting riparian areas. Yet significant opportunities remain for improving the extent of riparian buffers. The Natural

Resources Conservation Service (NRCS) recently estimated that in the Missisquoi River watershed alone there are more than 8,000 acres of stream and river corridor where riparian buffers are currently insufficient or non-existent.

Clean and Clear Program Summaries

ANR, AAFM and the Agency of Transportation produced joint annual reports on the Clean and Clear Action Plan for 2004, 2005, and 2006, which were delivered to the General Assembly and made available to the public in the spring of each following year. These reports detailed activities conducted by each program supported by Clean and Clear. The purpose of these annual reports was to: explain the sources of phosphorus being addressed by each program; describe the structure of the program; outline the activities conducted each year; and provide indicators and other measures of progress.

Similar program summaries for 2007 are provided in Appendix B that detail the major mobilization of resources and professional staff effort and the accomplishments and efficacy to date. Numerous water quality programs in ANR and AAFM that existed prior to Clean and Clean have been substantially expanded and enhanced, and several new efforts have begun. These programs work to reduce the phosphorus load delivered to the state's waters from sources such as wastewater discharges, barnyards, agricultural fields, unstable river channels, urban centers, residential areas, construction sites, back roads, and other areas.

Recommendations for Amending the Lake Champlain TMDL Implementation Plan

Section 4(a)(3) of Act 43 required that this report include "*recommendations, if any, for amending the implementation plan…*" ANR considers the implementation plan portion of the TMDL to be continually "open" in the sense that we must always be willing to learn from our efforts and redirect our implementation actions as we proceed. The State has continuously refined the approach originally laid out in the implementation section of the Lake Champlain TMDL. Most recently, this past summer a task force of ANR, AAFM, and NRCS staff developed a work plan for the Center for Clean and Clear[6]. In developing the work plan, staff considered accomplishments under Clean and Clear in programs such as stormwater management, agricultural water quality regulation, and river management, and honed in on areas of the lake where the continued implementation of existing programs is unlikely to be sufficient to achieve water quality standards within a reasonable timeframe. The draft work plan proposes a number of specific changes to ANR and AAFM efforts under the Clean and Clear program, including a series of enhanced pollutant reduction measures that will first be implemented in the northern lake watershed. Key recommended changes include:

- Increasing emphasis on unregulated non-point source pollution (e.g., targeted changes in farm field practices, in-channel stream/river erosion, non-jurisdictional stormwater)
- Moving from an applicant-driven approach to actively identifying opportunities for improving water quality, so that we pursue those projects that promise the greatest water quality benefits regardless of initial landowner interest
- Targeting a more limited geographic area – focusing on the areas with the most profound impacts in order to develop a site-specific plan, starting with the northern lake
- Adopting an ecosystem perspective, supported by program and agency integration
    - Creating a functional structure and physical location that will ensure a coordinated, collaborative approach
    - Improving communication and "technology transfer" between the individual parts of the Clean and Clear program, both within ANR and between ANR and AAFM

The State needs the flexibility to change and adapt its phosphorus management strategies as necessary without having to go through an extensive TMDL revision and approval process. Further, although Vermont's TMDL implementation plan was folded into the larger Lake Champlain TMDL document submitted to and approved by EPA, development of an implementation plan is not required by current federal law and therefore it is not necessary to reopen the TMDL in order to revise the implementation plan. The ability to routinely revisit, reevaluate, modify, and adapt the implementation plan is essential, applying what has been learned from past watershed-based actions and producing improvements in the landscape and water quality in as efficient and effective a manner as possible. In complex systems we need to act in order to learn; a "living" implementation plan is central to the process of action.

[6] Center for Clean and Clear DRAFT Work Plan, released August 29, 2007 http://www.anr.state.vt.us/imaging/ANRdocs/secoffice/TVWF/CCC/General%20Documents/CCCworkplan-public-review-draft-with-appendices-070829.pdf

Recommendations on Reopening the Lake Champlain Phosphorus TMDL

Section 4(a)(3) of Act 43 required that this report include "*recommendations, if any, for… reopening [the] TMDL*." Section 5 of Act 43 lists several potential purposes for reopening the Lake Champlain TMDL, including:

- Adopting a new hydrologic base year
- Allocating load reductions on a sub-watershed basis
- Ensuring that wastewater phosphorus discharges do not exceed the 2006 aggregate load
- Providing reasonable assurances
- Targeting critical source areas

It is not appropriate to reopen the Lake Champlain Phosphorus TMDL at this time, for the following reasons. These points are discussed in more detail in following report sections.

1. At this time, it is not necessary to adopt a new hydrologic base year for the TMDL in order to refine estimates of the total lake loading capacity or the estimated load reductions needed to attain water quality standards. The direction provided by the current TMDL target is both sufficient and clear – substantial reductions are need in the phosphorus load being delivered to Lake Champlain.

2. The Lake Champlain TMDL already allocates total loading capacities on a sub-watershed basis.

3. Implementing a policy that effectively requires reductions at all wastewater facilities in the Lake Champlain basin discharging more than 200,000 gallons per day is not an efficient or cost-effective strategy for making progress toward the phosphorus loading targets established in the TMDL.

4. The U.S. Environmental Protection Agency reviewed and approved the Lake Champlain Phosphorus TMDL in 2002. The EPA approval indicated that the TMDL document provided the necessary reasonable assurances that the non-point source load reductions would be achieved. Since 2002, Vermont has increased these assurances through its commitment to the Clean and Clear Action Plan funding development and implementation of the programs described in the TMDL implementation plan.

5. It is not necessary to reopen the TMDL in order to incorporate critical source area identification into the targeting of phosphorus reduction efforts. It is already our plan to develop, apply, and refine those methods, starting in the northern lake watersheds through the work of the Center for Clean and Clear.

As described above, Act 43 identified a number of technical considerations related to reopening the TMDL. There are also a number of policy-related matters that should factor into this discussion, as they have significant implications. These include:

- It would be necessary to renegotiate any changes in the phosphorus total loading capacities with New York and Quebec and obtain EPA approval for the changes.
- A limit on wastewater discharges at the 2006 aggregate level (or "cap") could preclude additional or new municipal, agricultural, or industrial point source discharges of phosphorus beyond those allocated within the TMDL. There is no load allocated to "new sources" in the TMDL, so the only way a new facility could be brought on-line is through trading for existing phosphorus loading capacity. A 2006-based aggregate cap would severely limit the opportunity for acquiring an allocation through trading for unneeded capacity with an existing facility.
- A limit on wastewater discharges at the 2006 aggregate level could limit the ability of towns to expand municipal wastewater treatment service capacity in downtown areas or other designated growth centers, forcing new development into outlying areas that rely on on-site sewage disposal.
- Reopening a TMDL of this size and complexity would be a time-consuming process that would involve a tremendous amount of staff resources that would otherwise be spent advancing the necessary phosphorus reduction actions in the lake watershed.

Adopting a New Hydrologic Base Year

Section 5 (a)(1)(A) of Act 43 indicates that one of the purposes in reopening the Lake Champlain Phosphorus TMDL would be to "*Adopt a new hydrologic base year to reflect the average phosphorus load discharged to Lake Champlain between 1993 and 2004.*" In order to understand the full implications of changing the hydrologic base year, it is necessary to review: (1) the basis for selecting the base year used in the TMDL, (2) the results of long-term phosphorus load monitoring on Lake Champlain tributaries, and (3) the influence of hydrologic terms within the mathematical model used to establish phosphorus total loading capacities for the lake.

The 1991 Hydrologic Base Year

The Lake Champlain Phosphorus TMDL defined phosphorus loading capacities for each segment of the lake. These total loading capacities were determined from a phosphorus mass balance model that was based on the hydrologic conditions of 1991. Hydrologic conditions include the amount, intensity, and timing of rainfall and snowmelt during the year and attendant stream flows. These conditions influence the amount of water and phosphorus carried to the lake by rivers and streams. The 1991 hydrologic base year was chosen for the modeling analysis because annual average river flows to the lake during 1991 were similar to long-term annual average flows recorded by the U.S. Geological Survey at major gage stations, and because comprehensive phosphorus loading data were

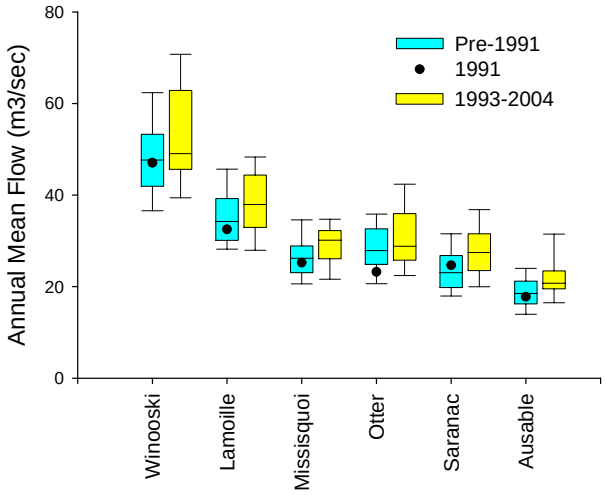


Figure 1. Annual mean river flows at six long-term U.S. Geological Survey gages in the Lake Champlain Basin for pre-1991, 1991, and 1993-2004 time periods. Box plots show median (midlines), 25th to 50th percentile intervals (boxes), and 5th and 95th percentiles (endcaps) for the distributions of annual mean flows within each time period.

available for 1991 from a phosphorus budget study on the entire lake[7].

Annual mean stream flow rates during 1991 in the six largest rivers in the Lake Champlain Basin are compared in Figure 1 with the range of annual mean flows throughout the entire period of record (six decades or more) for each gage prior to 1991. Annual mean flows during 1991 were fairly typical of the preceding long-term record. Mean 1991 flows in the Winooski, Lamoille, Missisquoi, Saranac, and Ausable Rivers were very near the long-term median values. Only the Otter Creek had a mean flow during 1991 that was outside (below) the middle 50th percentile interval for the prior long-term record. Annual mean flows in these rivers have been generally higher during 1993-2004 than during the pre-1991 period of record (Figure 1).

Phosphorus Load Monitoring Results

Phosphorus loads from 18 major Lake Champlain tributaries have been measured since 1990 as part of long-term water quality monitoring programs conducted by Vermont DEC and New York State DEC with the support of the Lake Champlain Basin Program[8]. The Lake Champlain Basin Program's 2005 State of the Lake Report[9] summarized the status and trends of phosphorus loading in each of these tributaries (Figure 2), based on methods documented in a previously published technical paper[10].

Figure 2. Status and trends in tributary phosphorus loading to Lake Champlain, 1990-2004. Status assessments are relative to watershed loading targets established in the Lake Champlain Phosphorus TMDL. Trend analyses were conducted on flow-adjusted total phosphorus concentrations.

The phosphorus loads from each of the 18 rivers were summed over two-year time intervals between 1993-2004 and extrapolated to the lake's entire watershed area including unmonitored drainage areas in order to produce estimates of the total loading to the lake from Vermont, New York, and Quebec. These total lake loads are compared with the estimates derived from the 1991 base year estimate in Figure 3. The wastewater discharge (point source) portions of the total loads are also shown in Figure 3. It is

[7] Vermont DEC and New York State DEC. 1997. A phosphorus budget, model, and load allocation strategy for Lake Champlain. Lake Champlain Diagnostic-Feasibility Study Final Report. Waterbury, VT and Albany, NY. http://www.anr.state.vt.us/dec/waterq/lakes/docs/lp_lcdfs-finalreport.pdf

[8] Lake Champlain Long-Term Water Quality and Biological Monitoring Project. http://www.anr.state.vt.us/dec/waterq/lakes/htm/lp_longterm.htm

[9] Lake Champlain Basin Program 2005 State of the Lake Report. http://www.lcbp.org/PDFs/sol_web.pdf

[10] Medalie, L. and E. Smeltzer. 2004. Status and trends of phosphorus in Lake Champlain and its tributaries, 1990-2000. pp. 191-219 *In* Manley, T.O., P.L. Manley, and T.B. Mihuc (eds.) Lake Champlain: Partnerships and Research in the New Millennium. Kluwer Academic/Plenum. NY. http://www.anr.state.vt.us/dec/waterq/lakes/docs/lp_phosstatustrends.pdf

important to note the ever-smaller contribution of wastewater discharges to the total phosphorus loading delivered to the lake, which is now less than 10% of the total load delivered annually.

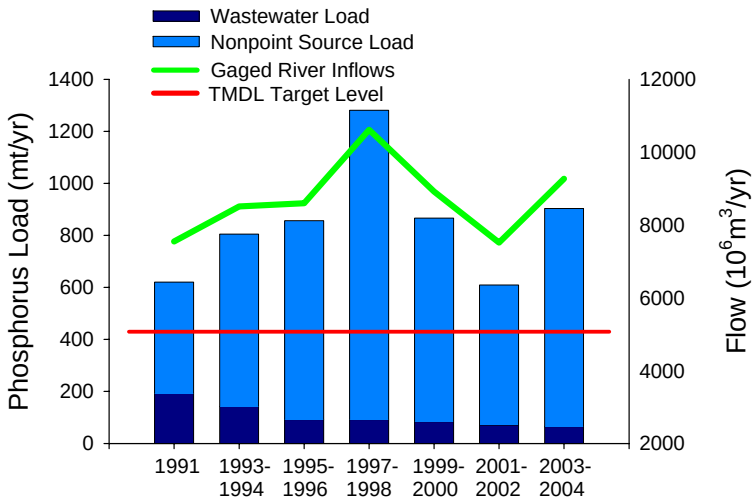


Figure 3. Phosphorus loading rates to Lake Champlain from point (wastewater) and non-point sources in Vermont, New York, and Quebec during 1991-2004, and total water inflow rate from 18 river gages in the Lake Champlain Basin. The basinwide total loading capacity established in the Lake Champlain Phosphorus TMDL is shown for comparison.

Phosphorus loading to the lake has remained well above the overall TMDL target level of 427 metric tons per year, and has also been greater than loading rates measured during the 1991 base year (630 mt/yr) during most of the 1993-2004 time period. The interpretation of Figure 3 is complicated by the fact that the loading variations seen between individual time intervals were primarily related to variations in total water inflow rates. During wet periods such as 1997-1998, more phosphorus was brought into the lake simply because the water runoff volume was greater. Similarly, during drier periods such as 2001-2002, less phosphorus was brought into the lake due to lower overall runoff volumes.

To fully evaluate the monitoring data and discern trends that may be linked to watershed management actions, it is necessary to statistically control for the influence of rainfall and the attendant in-stream flow response on the phosphorus loading rates. Otherwise, beneficial load-reducing effects of phosphorus control actions could be obscured by natural variations in precipitation and stream flow. The results of the trends analysis shown in Figure 2 were based on a statistical analysis using flow-adjusted concentrations. Seven of the rivers actually showed decreasing phosphorus trends when natural hydrologic variability was controlled in the statistical analysis (i.e., at a given flow condition, lower in-stream phosphorus concentrations have been measured in recent years).

Because the hydrologic reference conditions are moving targets, it is more appropriate to view the in-lake phosphorus concentration standards established for each lake segment, and the phosphorus total loading capacities given in the TMDL for each lake segment watershed, as the primary management goals, rather than the calculated load reduction amounts. It is simply not possible, nor would it make sense, to reopen the TMDL to redefine load reduction amounts every time weather patterns shift. Instead, continued monitoring and appropriate statistical analysis of phosphorus loading rates and trends relative to the total loading capacities defined in the TMDL should be used to evaluate progress in achieving these goals.

Modeling Phosphorus Total Loading Capacities

The phosphorus mass balance model used to construct the Lake Champlain TMDL accounted for a number of variables, including: phosphorus loading to each lake segment, water inflow from runoff and direct precipitation, circulation between adjacent lake segments, and sedimentation of phosphorus out of the water column. Reopening the TMDL to change the hydrologic base year

would require the modeling process to be redone using new model input terms reflecting the 1993-2004 hydrology, since flow conditions influence the determination of phosphorus total loading capacities.

The phosphorus total loading capacities defined in the Lake Champlain TMDL were the result of a complex process of negotiations between New York, Quebec, Vermont, and the EPA that required several years to complete. If the TMDL were reopened, this intergovernmental process would need to be repeated. Without actually re-running the model and working through the negotiations process, it is not possible to predict the final set of new total loading capacities that would be established for each lake segment watershed in Vermont, New York, and Quebec. However, some of the numeric consequences of using the model with new hydrologic input terms can be illustrated using the relatively simple example of the Missisquoi Bay lake segment, as presented below.

The basic phosphorus mass balance equation used in modeling Lake Champlain[7,11] is given below, solved for the total loading capacity (W) for a lake segment (in this case, Missisquoi Bay). The model terms are defined in Table 1.

$$W = C1\ (Q + E + k\ V\ C1) - E\ C2$$

Increasing the total water inflow (Q) will increase the total loading capacity (W) if all other terms in the equation remain the same. The numeric values that would apply to Missisquoi Bay are given in Table 1. Changing the hydrologic base period as directed by Act 43 would alter the water inflow term (Q) to increase from the 1991 value of 1,710 hm^3/yr to the average 1993-2004 value of 2,175 hm^3/yr. The consequence of this change would be an increase in the total loading capacity established for Missisquoi Bay from the current TMDL value of 97.2 mt/yr to a new value of 108.9 mt/yr (a 12% increase). Re-evaluating the hydrologic base year, therefore, is not only a matter of redefining the loading reductions needed, but would also involve reallocating the revised loading capacity between Vermont and New York and Quebec.

In short, since the phosphorus total loading capacities of Lake Champlain segments vary with the annual hydrologic conditions, one of the mathematical consequences of reopening the TMDL to use the 1993-2004 base period would be to increase the total loading capacities assigned to at least some of the lake segments. The end result would be less stringent loading capacity targets.

[11] Smeltzer, E. 1999. Phosphorus management in Lake Champlain. pp. 435-451 In Manley, T.O. and P.L, Manley (eds.) Lake Champlain in Transition: From Research Toward Restoration. Water Science and Application Vol. 1. American Geophysical Union. Washington, DC.
http://www.anr.state.vt.us/dec/waterq/lakes/docs/lp_phosmanage99.pdf

Table 1. Phosphorus model input values and calculated total loading capacities for Missisquoi Bay for the 1991 and 1993-2004 base hydrologic periods.

Model Term	Definition	Units	1991 Base Year Value	1993-2004 Base Period Value	Increase	Percent Increase
C1	Phosphorus concentration criterion for Missisquoi Bay	mg/l	0.025	0.025		
C2	Phosphorus concentration criterion for the Northeast Arm	mg/l	0.014	0.014		
Q	Total water inflow rate from rivers and direct precipitation	hm^3/yr	1710	2175	465	27%
E	Exchange flow rate between lake segments	hm^3/yr	297	297		
k	Sedimentation coefficient	$m^3/g\text{-}yr$	400	400		
V	Volume of bay	hm^3	205	205		
W	Phosphorus total loading capacity	mt/yr	97.2	108.9	11.7	12%
	Measured phosphorus loading rate to the bay	mt/yr	167.3	213.0	45.7	27%
	Phosphorus loading reduction needed	mt/yr	70.1	104.1	34.0	49%

Summary of Findings on Adopting a New Hydrologic Base Year

1. Annual phosphorus loading rates are highly correlated with river flows. As would be expected, the higher flows during 1993-2004 brought greater annual loads of phosphorus to Lake Champlain than were measured during 1991.

2. The phosphorus reduction amount needed in any given year to achieve the maximum loading capacity specified in the TMDL is a moving target, dependent on the weather. It does not make sense to reopen the TMDL to redefine load reduction amounts every time weather patterns shift. As such, load reduction amounts must be expressed relative to loads measured during a specified reference period and therefore the phosphorus total loading capacities given in the TMDL for each lake segment watershed, rather than the calculated load reduction amounts, should be viewed as the primary management targets.

3. Progress, or lack of progress, in achieving the TMDL target loads can be evaluated effectively without changing the hydrologic reference period. These evaluations can be made by comparing the actual phosphorus concentrations in the lake to the applicable in-lake water quality standards, and by comparing the measured phosphorus loads to the total loading capacities.

4. A mathematical consequence of reopening the TMDL modeling analysis to use hydrologic data for the 1993-2004 period would be to increase the total loading capacities assigned to at least some of the lake segments, resulting in less stringent phosphorus loading targets.

Allocating Load Reductions on a Sub-Watershed Basis

Section 5 (a)(1)(B) of Act 43 indicates that if the Lake Champlain Phosphorus TMDL were to be reopened, ANR should "*Allocate point source and non-point source load reductions on a sub-watershed basis*." However, the Lake Champlain TMDL already specifies the phosphorus allocations and reductions needed on a subwatershed basis. In fact, the TMDL specifies total phosphorus loading capacities for the 20 subwatersheds in the Lake Champlain Basin in Vermont, New York, and Quebec listed in Table 2. The total loading capacities (and reduction amounts) for each of these 20 sub-watersheds are further subdivided into allocations to four categories of sources: wastewater discharges, developed land, agricultural land, and forest land.

Table 2. Loading capacities established for Lake Champlain subwatersheds.

Lake Segment Watershed	TMDL Total Loading Capacity (mt/yr)
Vermont	
South Lake B	20.8
South Lake A	0.6
Port Henry	0.1
Otter Creek	56.1
Main Lake	76.6
Shelburne Bay	12.0
Burlington Bay	5.8
Malletts Bay	28.6
Northeast Arm	1.2
St. Albans Bay	8.0
Missisquoi Bay	58.3
Isle LaMotte	0.3
Quebec	
Missisquoi Bay	38.9
New York	
South Lake B	23.9
South Lake A	11.2
Port Henry	3.4
Otter Creek	0.0
Main Lake	33.7
Cumberland Bay	25.2
Isle LaMotte	22.3

Ensuring that Wastewater Phosphorus Discharges Do Not Exceed the 2006 Aggregate Load

Section 5 (a)(1)(C) of Act 43 would require ANR to *"Ensure that the total annual phosphorus load discharged by all wastewater treatment facilities in the aggregate does not exceed the total phosphorus load discharged to Lake Champlain by all wastewater treatment facilities in the aggregate in 2006."*

It is not cost-effective or environmentally-efficient to use the TMDL to restrict the aggregate wasteload allocation for Vermont wastewater treatment facilities in the Lake Champlain Basin to the total phosphorus load discharged by these facilities during 2006. The reasons for this position are summarized briefly below and discussed in more detail in later sections of this report.

- Attainment of the 2006 aggregate load at design flow for all facilities in the Lake Champlain basin would necessitate the imposition of a 0.2 mg/L effluent limit at all 26 facilities discharging more than 200,000 gpd, as well new 0.8 mg/L limits at four smaller facilities. It would not allow for site-specific evaluation as to type of and locations where additional treatment measures might be effective or appropriate.
- The cost to upgrade these 30 facilities to provide additional phosphorus removal treatment sufficient to maintain the aggregate total load at 2006 levels, while allowing for sewage flows up to currently permitted amounts, would be very high. The estimated capital cost would be $59 million. There would also be additional annual operating costs borne by each facility.
- The cost per ton of phosphorus reduced annually through this level of phosphorus removal treatment would be much higher (between 10 and 1000 times greater) than the

cost per annual ton that could be reduced through a number of different non-point source control practices.

- A limit on wastewater phosphorus discharges at the 2006 aggregate level would require such low effluent phosphorus concentrations at most Vermont facilities that it could preclude additional or new municipal, agricultural, or industrial point source discharges of phosphorus beyond those already allocated within the TMDL. There is no load allocated in the TMDL to "new sources" and such a cap would severely limit the opportunity for acquiring an allocation through trading for unneeded capacity at an existing facility.
- A limit on wastewater discharges at the 2006 aggregate level could promote sprawl by limiting the ability of towns to provide municipal wastewater treatment capacity in downtown areas or other designated growth centers. New development would be forced into outlying areas where onsite sewage disposal capacity exists.
- Vermont wastewater phosphorus discharges have already been reduced by 80% from their 1991 levels and these point sources now represent less than 10% of the total phosphorus load to Lake Champlain. It is imperative that funding priority now be given to reducing non-point sources which make up 90% of the current load to the lake.

Providing Reasonable Assurances

Section 5 (a)(1)(D) of Act 43 states that reopening the Lake Champlain Phosphorus TMDL would allow ANR to "*Amend pollutant load allocations within the TMDL so as to reduce point source and non-point source load allocations in order to reasonably assure that the TMDL meets the Vermont water quality standards*."

When a TMDL is developed for waters impaired by both point and non-point sources, and the wasteload allocation is based on an assumption that non-point source load reductions will occur, EPA's 1991 TMDL Guidance states that the TMDL should provide reasonable assurances that non-point source control measures will achieve expected load reductions in order for the TMDL to be approvable. This information is necessary for EPA to determine that the TMDL, including the load and wasteload allocations, has been established at a level necessary to attain water quality standards[12]. These assurances typically include a combination of non-regulatory, regulatory, or incentive-based measures, consistent with applicable laws and programs[13].

The Lake Champlain Phosphorus TMDL provided reasonable assurances that the necessary non-point source phosphorus load reductions would be achieved by pointing out the commitments made by Vermont, New York, and Quebec to implement *Opportunities for Action*, the comprehensive basin plan for Lake Champlain. This plan, originally developed in 1996 and renewed in 2003, includes a phosphorus reduction agreement and implementation plan as one of its key elements. Both documents were signed by the Governors of Vermont and New York and the Regional Administrators of EPA.

[12] USEPA Guidelines for Reviewing TMDLs Under Existing Regulations Issued in 1992. http://www.epa.gov/owow/tmdl/guidance/final52002.html

[13] USEPA. August 8. 1997 memorandum. New policies for establishing and implementing Total Maximum Daily Loads (TMDLs). http://www.epa.gov/OWOW/tmdl/ratepace.html

In approving the Lake Champlain Phosphorus TMDL in 2002, the EPA specifically determined that the reasonable assurances in the TMDL were sufficient and consistent with EPA policy. Since 2002, Vermont has followed through on its phosphorus reduction commitment by initiating the Clean and Clear Action Plan. This initiative has resulted in the appropriation of over $65 million in state and federal funds to date, the vast majority of which has been directed at reducing non-point sources of phosphorus pollution to Lake Champlain.

The control of non-point source pollution is inexact; although the performance of individual practices can be estimated and/or measured, absolute guarantees regarding phosphorus reduction in the lake within specific time frames cannot be made. What is needed is a concurrent process of action and learning, that allows implementation to proceed while continuing to study and learn. As described in the Center for Clean and Clear's draft work plan, adaptive implementation will allow us to act in order to learn, improving our understanding of non-point source pollution control and our ability to develop and implement efficient and effective solutions. Further, the mutual commitments made by each government in the Lake Champlain basin, and the major allocation of resources in Vermont provided through the Clean and Clear Action Plan, represent reasonable assurances that the necessary non-point source reductions will be achieved.

Targeting Critical Source Areas

Section 5(b) of Act 43 indicates that one of the purposes of reopening the Lake Champlain Phosphorus TMDL would be to "*include a strategy for identifying and targeting critical source areas for non-point source pollution in each subwatershed.*"

It is not necessary to reopen the Lake Champlain Phosphorus TMDL in order to incorporate critical source area identification into the targeting of phosphorus reduction efforts. Identifying and targeting critical source areas is an approach that is already being further developed for phosphorus reduction in the Lake Champlain basin. Several approaches to critical source area identification on both agricultural and developed land are discussed and recommended in the draft work plan for the new Center for Clean and Clear[14].

There are techniques available for targeting critical source areas at various spatial scales. Some approaches identify very specific sites within a single farm that yield disproportionate amounts of water and phosphorus runoff. On a whole-watershed scale, sampling and geographic modeling methods can be used to identify sub-watersheds that yield especially high amounts of phosphorus. A grant using Clean and Clear funds has been awarded to the University of Vermont to develop a phosphorus tracking system for the Lake Champlain basin, including a quantitative assessment of the major phosphorus-generating processes at work in the basin.

[14] Vermont Agency of Natural Resources. August 29, 2007 draft workplan for the Center for Clean and Clear. http://www.anr.state.vt.us/imaging/ANRdocs/secoffice/TVWF/CCC/General%20Documents/CCCworkplan-public-review-draft-with-appendices-070829.pdf

Analysis of the Feasibility and Cost of Implementing Additional Phosphorus Removal at Wastewater Treatment Facilities

Section 4(b) of Act 43 required that this report include an analysis of "*methods for and the cost of reducing phosphorus discharges from wastewater treatment facilities in the Lake Champlain basin*." Vermont's long-term program to reduce wastewater discharges of phosphorus to Lake Champlain represents a major success story. During the 1970s, wastewater discharges made up nearly half of the total phosphorus load delivered annually to Lake Champlain. Over the last 30 years, Vermont's policies have reduced wastewater phosphorus loads to Lake Champlain by 90% (Figure 4).

In the mid-1970s, Vermont wastewater facilities discharged more than 200 metric tons of phosphorus per year. With the passage of a ban on phosphorus in laundry detergent in the late-1970s and the establishment of a 1.0 mg/L effluent limit for selected facilities, the annual load decreased by an estimated 40%. And with the statutory adoption of a 0.8 mg/L limit on phosphorus in wastewater discharges in 1991, loads again fell significantly as plants were upgraded to meet the new limit. Although the 1991 law made great strides, it exempted a number of aerated lagoon systems which were allowed to continue to discharge at pre-1991 levels. The exemption for large aerated lagoons was removed following the adoption of the Lake Champlain TMDL, and upgrades at five lagoon facilities are now either in planning or are substantially complete.

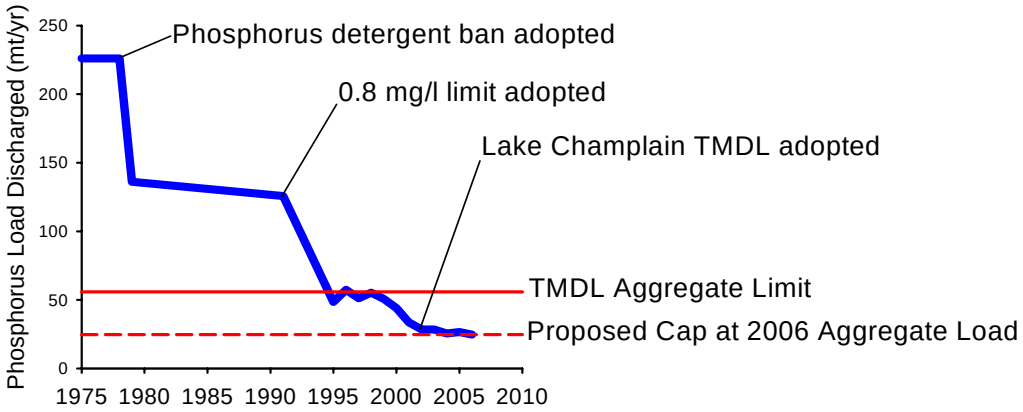


Figure 4. Long-term trends in phosphorus loads to Lake Champlain from Vermont wastewater facilities

Some have argued that lower limits like 0.2 mg/L or 0.1 mg/L should be imposed because they represent effluent concentrations that could be reliably achieved with installation of the best available technology. Even these lower limits, however, would not ensure attainment of water quality standards in segments of the lake with the most significant phosphorus-related impacts, such as the northern lake watersheds where wastewater discharges are very small sources of phosphorus relative to non-point source loads. Reducing non-point source loads and, in some areas, controlling the internal phosphorus loading will be paramount in all efforts to improve water quality in the lake.

Also important is perspective on the phosphorus contribution from Vermont wastewater facilities relative to non-point source loads carried to the lake in tributary rivers. In every case, wastewater facilities contribute less than 10% - and in many instances less than 5% - of the total

phosphorus load in these rivers (Figure 5). Even completely eliminating phosphorus from wastewater discharges (an unrealistic option) would provide only a small increment of the reductions needed in order to achieve water quality standards.

2006 in the Aggregate

Act 43 would require phosphorus loads from wastewater facilities to be capped at the total phosphorus load discharged to Lake Champlain by all wastewater treatment facilities in the aggregate in 2006, or 24.7 mt/yr. Currently the cumulative phosphorus load from all wastewater facilities in Vermont is significantly below the 55.8 mt/yr allowed by the TMDL. The TMDL allows wastewater phosphorus loads to increase above their current levels in order to accommodate sewage treatment capacity that has already been built and permitted.

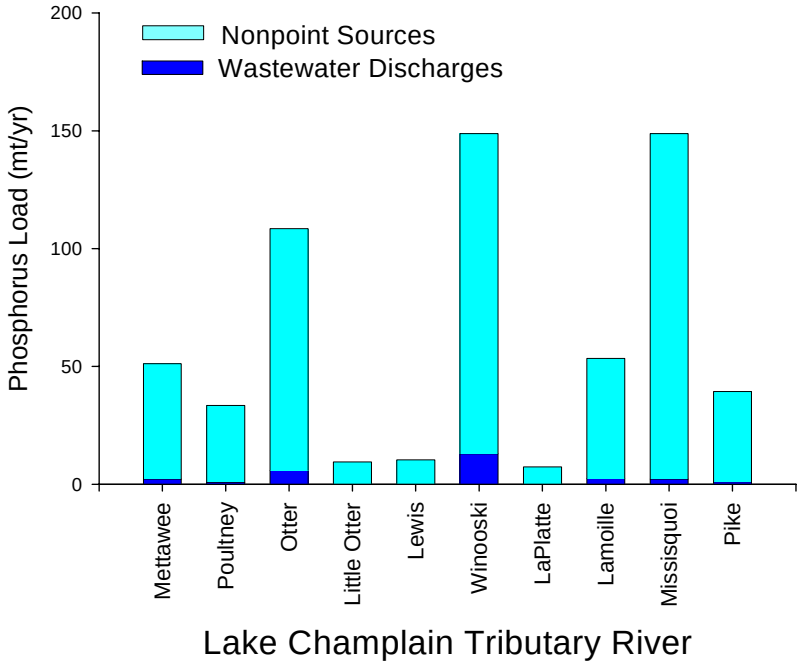


Figure 5. Average phosphorus loads delivered to Lake Champlain from major Vermont tributary rivers, 2000-2006.

The difference between the aggregate allocation for phosphorus load from these facilities in the TMDL and the phosphorus load discharged during 2006 is approximately 31 mt/yr. There are several reasons for this. Wastewater facilities are discharging below their permitted flow capacity. Specifically, wastewater facilities within the Lake Champlain basin currently treat an average of 46.7 million gallons per day (mgd), while the total flow permitted at these same facilities is 81.7 mgd.

In addition, wastewater facilities are removing more phosphorus than is required by their permits. Wastewater facilities must reliably meet phosphorus concentration limits established in their discharge permit on a monthly basis, so actual effluent quality is usually better/cleaner than that required by the permit. Currently wastewater facilities within the Lake Champlain basin, save one, have a permitted phosphorus effluent of 0.8 mg/L. Actual average effluent quality at these same facilities, however, is approximately 0.3 mg/L.

There are a number of implications associated with holding wastewater facilities to a load of "2006 in the aggregate." The TMDL does not explicitly provide for new loads, such as a new wastewater facility, and it was anticipated that some of the difference between allocations in the TMDL and current loads could be used to accommodate "trading" between dischargers (existing and/or new). Options for trading between wastewater dischargers would be extremely limited with a 2006-based cap. This policy would work counter to the preferred direction of land use in Vermont – namely directing development to areas that have wastewater capacity and that demonstrate traditional patterns of compact settlement.

Cost Analysis

The best current estimate of capital cost associated with limiting the aggregate wastewater phosphorus loading at full plant capacity in the Lake Champlain basin to the total load actually discharged during 2006 is $59 million, in 2008 dollars. There are 60 wastewater facilities discharging in the Vermont portion of the Lake Champlain basin; this effort would involve projects at 30 facilities.

Current phosphorus limitations, based on the TMDL allocation, represent what is achievable using chemical addition without filters. The next level of phosphorus removal technology is to employ chemical addition with filters; it is generally accepted that the addition of filters will consistently achieve 0.2 mg/L phosphorus. In short, the 0.2 mg/L represents the next level of phosphorus removal technology above and beyond what is currently being used. Our approach, therefore, was to analyze the cost of meeting a 0.2 mg/L effluent phosphorus limit under full permitted flow conditions at all facilities in the basin having permitted flows greater than 200,000 gpd, and then work downward in size among the list of facilities with less than 200,000 gpd permitted flow, applying a 0.8 mg/L phosphorus limit at these smaller facilities to the point where the aggregate 2006 load was achieved at full permitted flows. This approach was designed to estimate the minimum capital investment that would be needed to achieve the 2006 aggregate phosphorus load, as this was the specific policy directive given in Section 5 (a)(1)(C) of Act 43. As such, the rationale for starting with the largest facilities and working downward in size was to take advantage of the better economy of scale at the larger plants.

The costs to achieve the phosphorus concentration limits at permitted flows were used in this analysis because EPA regulations require wastewater treatment plants to have all the necessary facilities in place to reliably achieve their effluent limits at their full permitted flows in order for a discharge permit to be issued. A summary of existing phosphorus removal practices and the projected cost of meeting the necessary effluent phosphorus concentration limits for each facility in the Lake Champlain basin is presented in Appendix C.

Filtration would need to be added at 26 municipal plants, all larger than 200,000 gpd capacity, and chemical addition would need to be installed at four additional municipal plants – Williamstown, Plainfield, Wallingford and North Troy – with capacities ranging from 100,000 to 200,000 gpd. Currently, facilities with design flows less than 200,000 gpd are exempt from additional phosphorus treatment requirements, with the exception of new discharges. The $59 million does not include any projection of the changes in operational costs associated with these practices, although these annual operational costs are anticipated to be significant, nor does it provide an allowance for capital needs related to biosolids handling.

In addition, the analysis assumed that phosphorus allocations for nine other municipal plants would be reduced, based on their existing facilities (filters or biological phosphorus removal or land application already in place) and/or treatment performance data that demonstrate their ability to achieve lower phosphorus levels. No capital projects would be required at these nine facilities. None of the three large industrial dischargers – IBM in Essex Junction, Rock Tenn paper mill in Sheldon Springs, and PBM Nutritionals in Georgia – would need to implement additional phosphorus removal practices, but the phosphorus allocation in the existing permits for IBM and PBM Nutritionals would need to be tightened on the basis of their existing facilities,

actual treatment performance, and future flow prospects, in order to meet the 2006 aggregate limit.

The wastewater treatment improvements described above would prohibit the potential increase of 31 mt/yr of phosphorus currently allowed under the TMDL (i.e., the difference between the total wastewater allocation of 55.8 mt/yr and the actual 2006 load of 24.7 mt/yr). This increase, however, would occur only gradually over many years as new connections are made and it is unlikely to ever be fully realized. In fact, there has been no increasing trend in the total wastewater flow from all municipal facilities in the Lake Champlain Basin over the past 15 years, although some individual facilities have expanded. Actual phosphorus load reductions in the near term would be far less than 31 metric tons per year. So, in effect, the $59 million capital investment would mostly maintain the *status quo* in terms of wastewater phosphorus load delivered to the lake and therefore lake water quality, and the cost of "preventing" one metric ton per year of phosphorus under this scenario is $1,900,000.

Incentives to Voluntarily Reduce Phosphorus Loads at Wastewater Facilities

Section 4(b) of Act 43 required that this report "*Recommend incentives that would encourage wastewater treatment facilities… to reduce voluntarily phosphorus discharges.*" As with any business faced with voluntary expenditures, wastewater facilities would weigh the costs and benefits of what it required by Act 43. It seems unlikely these facilities would voluntarily make the significant capital investments necessary to achieve what is required by Act 43 given the dubious benefits.

There are options, however, that could be considered to encourage the continued high performance of Vermont wastewater facilities when it comes to phosphorus removal in order to ensure wastewater facilities seek to minimize total phosphorus discharged. Options might include:

- Putting in place financial a series of financial incentives that reward high performance; such standards could be tied to either an effluent phosphorus concentration and/or total load.
- Adding conditions to NPDES permits requiring facilities employ best management practices when it comes to limiting phosphorus in wastewater discharges.
- Assessing a per unit phosphorus charge to wastewater facilities whose total annual load exceeds some pre-determined threshold. This money could then be dedicated to fund non-point source phosphorus reduction projects. This would attach a real cost to increasing pollution, and it would increase resources available for funding non-point source control projects.

Setting Priorities for Improving Water Quality in Lake Champlain

Any evaluation of various strategies for improving water quality in Lake Champlain must recognize that not all sources contribute equally and not all lake segments are equally affected. Controlling non-point source pollution is integral to any viable solution to the reduce phosphorus loads being delivered to Lake Champlain. The control of non-point source pollution presents a major technical challenge both in the Lake Champlain basin and nationwide. It is important to critically evaluate the Clean and Clear implementation efforts as they are being carried out in order to ensure that these efforts are focused on the highest priority sources in the most cost-effective manner possible.

While improvements at wastewater treatment facilities appear to be "easy" because results can be definitively measured in terms of pounds of phosphorus, these projects are not cost-effective. We have passed the point of diminishing returns at Vermont's wastewater treatment facilities. To focus disproportionately on wastewater now only diverts resources from the essential task of comprehensively addressing non-point source pollution.

Non-point source control can also be extremely cost-effective when compared to additional wastewater treatment. The most dramatic example of this is related to agricultural livestock exclusion:

> *A research study of water quality improvements following riparian zone restoration along small streams adjacent to farmland within the Missisquoi River watershed documented significant phosphorus reductions from treatments such as fencing, provision of alternative water supplies, protection of stream crossings, and streambank bioengineering*[15]*. Phosphorus loading in one stream was reduced by 0.8 metric tons per year at a cost of less than $3,800. The cost-effectiveness of these simple riparian practices (about $5,000 per metric ton per year of phosphorus reduced) is orders of magnitude better than the $1.9 million per metric ton per year of phosphorus prevented by the additional wastewater treatment requirements analyzed earlier in this report. Sediment and bacteria levels were also reduced by these treatments.*

Given all of the issues raised herein, ANR takes the following position related to on-going and future efforts to improve water quality in Lake Champlain:

1. Reopening the TMDL would require an investment of significant resources that would otherwise be dedicated to developing and implementing projects to improve water quality in Lake Champlain.
2. The cost of implementing additional phosphorus reductions at wastewater treatment facilities is substantial and must be considered carefully.

[15] Meals, D.W. 2004. Water quality improvements following riparian restoration in two Vermont agricultural watersheds. pp. *In* T.O. Manley, P.L. Manley, and T.B. Mihuc (eds.). Lake Champlain: Partnership and Research in the New Millennium. Kluwer Academic/Plenum Publishers. New York.

3. Non-point sources are now responsible for more than 90% of the phosphorus load being delivered to Lake Champlain and must be the focus of water quality programs going forward.
4. Amending the TMDL implementation plan does not require reopening the TMDL.
5. The quality and the volume of work produced by the Agencies of Natural Resources and Agriculture, Food and Markets (AAFM) as a result of the Clean and Clear program are extensive.

For the past four years, through Clean and Clear, ANR and AAFM have expanded and enhanced implementation of broad-based water quality programs throughout the Lake Champlain basin, and to some extent the state, including: hydrology-based stormwater management, agricultural water quality regulation, river management, watershed planning, wetland restoration, and local road improvement. These programs provide important services for moving the Lake Champlain basin, and the state as a whole, toward achievement of state water quality objectives. In building on this foundation, through the Center for Clean and Clear, ANR and AAFM have charted a course targeting the sources of phosphorus pollution having the most profound effect on water quality in Lake Champlain – non-point sources.

Appendix A: List of Public Meeting Attendees

A list of attendees at the three public meetings is included below, and a copy of the Agency presentation materials is available at the Clean and Clear website:
http://www.anr.state.vt.us/cleanandclear/news/Act43-121007.pdf

Act 43 Public Hearing – List of Attendees
12/5/2007 – Swanton

Name	Organization/Town,City
Megan Moir	ANR-DEC
Mike Winslow	Lake Champlain Committee
Jim Fitzgerald	St. Albans City-VT Legislature
Heath McAllister	Farmers Watershed Alliance-Swanton
Roger Rainville	Farmers Watershed Alliance -Alburgh
Mark Sweeny	VSFWS-Missisquoi NWR, Swanton, VT
Staci Pomercy	DEC
Jonathan Elwell	Village of Enosburg Falls, VT
Michel Consejo	State Representative
Pixley T. Hill	Friends of Missisquoi Bay
Eric Wolinsky	SAAWA
Allen Robtoy	St. Albans
Brian H. Willett	St. Albans WWTP
Jim Irish	Swanton WWTP
Art Stemp	NYSDEC
Fred Dunlap	NYSDEC, Water, Raybrook, NY
Dick Longway	Dairy Farmer, Swanton, F.W.A.
Aleksandra Drizo	University of Vermont, Burlington
Leon Thompson	St. Albans Messenger
Don Phillips	Forcier Aldrich & Assoc.
Sen. Sara B. Kittell	Legislature
Nancy Patch	Franklin-Grand Isle County Forester
Chris O'Shea	Franklin Watershed Comm/MRBA
Loretta Wood	St. Albans Area Watershed Assoc.
Robert Wood	St. Albans Area Watershed Assoc.
Tom Joslin	DEC, Facilities Engineering Division
Laura Pelosi	DEC Commissioner
Robert Pelosi	ANR
Mary Borg	Attorney, DEC Water Quality Division
Kathy Lavoie	State Representative
Peter Rath	St. Albans Bay Area Watershed
Paul Madden	Friends of Missisquoi Bay
Heather Darby	UVM Extension, St. Albans, VT
Barry Gruessner	VT ANR
Jim MacKenzie	MRBA/SAAWA, Swanton
Chris Smith	USFWS

Act 43 Public Hearing – List of Attendees
12/10/2007 – Burlington

Name	Organization/Town,City
David Kost	IBM
James Jutras	Village of Essex Jct.
Buzz Hoerr	VT CAC
Ginny Lyons	VT CAC/VT Senate
Lori Fisher	Lake Champlain Committee
Jan Peterson	VT CAC
Roger Hunt	Town of Milton
Alec Tuscany	Village of Waterbury
Patrick Hewlett	IBM
David Borthwick-Leslie	Town of Grand Isle
Terry O'Brien	Friend of Missisquoi Bay
John Forcier	Forcier Aldrich
Bryan Osborne	Town of Colchester
JuliBeth Hinds	City of South Burlington
Eric Clifford	CAC
Jane Clifford	Green Mt. Dairy Farmers Coop.
Megan Moir	ANR
Justin Johnson	ANR/DEC
Tom Joslin	ANR/DEC
Laurie Adams	Burlington Public Works
Tim Grover	Burlington Public Works
Rick Hopkins	VT DEC-WQD
Pam Stetanek	OCWRCD
Dan Sehecal-Albrecht	CCRPC
Tim Burke	CLF
Claire Ayer	VT CAC
Dawn Franci	LCRCC/GBIC
Phil Benedict	VAARM
Derek Coffron	Western Carolina U.
Mike Rapacz	VT Resident
Ken Jones	Green Mtn. Institute
James Ehlers	Lake Champlain International
Peter Kreisel	VT CAC
Gene Forbes	Hoyle, Tanner & Assoc.
Kim Greenwood	VNRC
Warren Coleman	VT ANR
Eric Smeltzer	VT ANR
Mary Watzin	UVM
Tom Berry	TNC
Roger C. Derby	Colchester Selectboard
Meg Modley	Lake Champlain Basin Program
Steve Berkett	Winding Brook Condo
Paul Hansen	VT CAC
Chris Robinson	Town of Shelburne Wastewater
Betty Steward	Ferrisburgh, VT

Wally Shonnard	Ferrisburgh, VT
Brendan Cosgrove	ANR
Steve Bozan	Citizen
Kitty Bozan	Citizen
Jarrod Becker	N. VT RC&D
Jim Kleptz	Farmer
Larry Dupont	VT CAC
Bill Howland	Lake Champlain Basin Program
Dexter Randall	VT CAC
John Zenie	VT CAC

Act 43 Public Hearing
12/20/2007 - Caselton

Name	**Organization/Town,City**
Kathleen Ramsey	Town of Pittsford
Michael A. Smith	Otter Creek Engineering
Sandy Kuehn	VT CAC, South Lake Group
Bill Kuehn	South Lake Group
Marli Rupe	Poultney-Mettawee Conserv. District
Laura Pelosi	ANR/DEC
Peter Laramie	Fair Haven Municipal Sewer
Joanne Calvi	Poultney River Committee
David Calvi	
Mark Goodrich	
Rep. Bob Helm	Vermont Legislature
Rep. Will Stevens	Vermont Legislature
Barb Woodard	Woodard Marine
Roland “Ted” Smith	Orwell Select Board
Tom Joslin	ANR/DEC

Appendix B: 2007 Clean and Clear Program Summaries

Section 4(a)(1) of Act 43 indicates that this report shall include "*an assessment of the implementation plan for the TMDL based on available data, including an evaluation of the efficacy of the implementation plan.*" To address this requirement, this appendix includes: (1) a brief summary of the status of each action item listed in the Lake Champlain Phosphorus TMDL implementation plan (Table B-1), and (2) an annual report on activities and measures of progress for each program supported by the Clean and Clear Action Plan. Annual summaries for 2007 are provided for each of the following Clean and Clear program areas.

Agencies of Natural Resources and Transportation Programs

Wastewater Discharges
River Management
Better Backroads
Stormwater Management
Erosion Control at Construction Sites
Local Municipal Actions
Wetland Protection and Restoration
Forest Watershed Management
St. Albans Bay Studies
Monitoring and Research
DEC Watershed Initiative

Agency of Agriculture Food and Markets Programs

Accepted Agricultural Practices Program
Pesticide and Groundwater Monitoring Program
Medium Farm Operations Program
Large Farm Operations Program
Best Management Practices and Alternative Manure Management Programs
Nutrient Management Grant Incentive Program
Farm Agronomic Practices Program
Conservation Reserve Enhancement Program

Table B-1. Implementation status of the Lake Champlain Phosphorus TMDL under the Clean and Clear Action Plan, updated December 2007.

TMDL Action Item		Status	Comments
Wastewater Discharges			
	Upgrade five aerated lagoon facilities	In progress	Richford upgrade is complete and operational. Troy/Jay installed chemical feed capability to meet their permit deadline of 2006. They are in preliminary planning for a significant flow increase, and portions of some elements (e.g., sludge handling) of that may be determined eligible for funding. The Hardwick upgrade has been has been constructed and is operational. Waterbury is in the late planning/basis of design phase. Proctor is in preliminary planning.
	Fund optional selector zone upgrades	No action	No requests for funding have been received from municipalities.
Watershed Planning			
	Establish watershed coordinators in all seven Lake Champlain planning basins	In progress with shift in scope	Five new watershed coordinators are at work, bringing the total number of watershed coordinators up to eight (one position is currently vacant). The scope has been expanded under Clean and Clear to include river basins statewide. The first two years of the Watershed Protection Assistance Program administered by the watershed coordinators has provided $150,000 for 32 locally important projects across the state.
River Management			
	Conduct stream geomorphic assessments	In progress	Phase 1 assessments have been conducted on 5,129 river miles in the Lake Champlain Basin, and Phase 2 assessments have been conducted on 980 river miles.
	Establish a statewide river management database	In progress	The database and GIS map serve have been established and operational at approximately a 75% level of projected full capability. Full capability is anticipated within one year.
	Build capacity to utilize and apply assessment data to achieve TMDL objectives	In progress	Dozens of municipal governmental entities, non-governmental organizations, watershed groups and others are engaged collaboratively with ANR in the application of assessment data to develop river corridor plans and identify specific restoration and protection projects to increase sediment and nutrient storage in stream channels and floodplains and resolve broad-based conflicts between fluvial dynamics and the land use investments of individuals and communities.
	Create fluvial erosion hazard maps	In progress	Mapping protocols and technology have been developed and river corridor fluvial erosion hazard maps are being drawn. Communities are beginning to embrace and utilize fluvial erosion hazard maps in local land use regulation. The maps are under development and are providing the basis for FEH corridor zoning in 61 municipalities statewide.
	Create incentives for local governments to	In progress	Limited incentives have been achieved through the River Corridor Grants

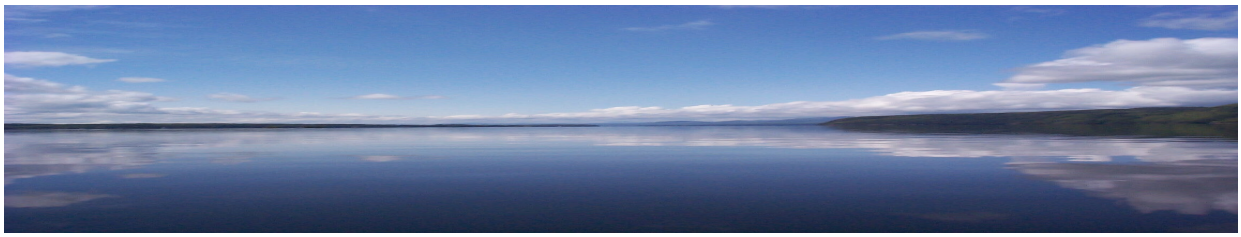
TMDL Action Item		Status	Comments
	adopt riparian corridor protection measures		program and FEMA pass-through grants.
	Expand agricultural BMPs to improve riparian corridor management by government funded programs	In progress	Agricultural regulatory emphasis on production areas and point source discharges of farms is curtailing progress on non-point source abatement. Progress has been made in applying and combining riparian corridor management practices (i.e., CREP and river corridor easements) to achieve sediment and nutrient discharge reductions. Progress is also being made in coordinating the application of USDA farm bill programs with River Management Program efforts.
	Expand forestry AMPs to protect streams draining land that is sensitive to bare ground (non-winter) harvesting	In progress with shift in scope	A watershed forester position has been established in the Department of Forests, Parks, and Recreation to support the AMP program, the Heavy Cutting Law, Act 250 review of high elevation logging, and a portable skidder bridge initiative.
	Improve flood hazard mitigation	In progress	Pre-disaster mitigation activities are underway at 10 of the 11 Regional Planning Agencies, in partnership with Clean and Clear and FEMA.
	Train consultants in stable stream restoration design	In progress	Over ten consultants have been trained by ANR in fluvial assessment, river corridor planning and river corridor restoration and design. Six are under contract.
	Conduct stream restoration demonstration projects	In progress	Recent demonstration projects include the Rugg Brook Flood Plain Restoration Project and the Lamoille Valley Rail Trail Flood Plain Restoration Project. Several other active restoration projects are in development.
	Conduct courses in fluvial geomorphic assessment	In progress	Three-day training sessions have been conducted for over 40 environmental consulting, planning, and non-profit organization partners. A broader collaboration in support of graduate level courses at academic institutions is currently under development at UVM.
	Prepare educational videos explaining stream channel adjustment processes	In progress	A DVD is available for public distribution and is running on public access TV throughout the state. Improvements and additional resources are planned.
	Prepare fact sheets addressing stable stream science and management topics	In progress	Fact sheets are available on the River Management Program (ANR) website. Additional publications are forthcoming.
	Conduct a comprehensive economic analysis of river corridor management alternatives	In progress	Significant progress is being made on generating qualitative conclusions and information. Technical and social feasibility criteria have been adopted as a part of the river corridor planning process to assist the alternatives analysis and watershed level prioritization of restoration and protection projects.
	Establish research partnerships	In progress	A research partnership with the Vermont Water Resources and Lake Studies Center at UVM has been established with state grant funds provided to support research on phosphorus generation mechanisms associated with fluvial processes.
	Coordination with emergency response and recovery activities	In progress	Integration of fluvial geomorphic considerations into flood recovery operations which avoid continued stream channelization and other actions that promote sediment delivery to the lake is an on-going activity.

Stormwater Management			
	Establish an enhanced stormwater management program with requirements for new stormwater operational permits based on the 2002 Vermont Stormwater Management Manual	In progress	The backlog of expired stormwater permits is being addressed. The number of new operational permits issued annually according to the 2002 manual has increased dramatically. Four new positions have been added to the DEC Stormwater Management Program (in addition to the four Erosion Control positions noted below).
	Issue Watershed Improvement Permits covering stormwater discharges in stormwater-impaired watersheds.	In progress with shift in scope	Stormwater TMDLs are being developed for the 17 stormwater-impaired watersheds (14 in the Lake Champlain Basin). Five of these TMDLs (Potash Centennial, Englesby, Morehouse, and Bartlett Brooks) have been approved by EPA. The remaining TMDLs are being drafted and all are expected to be completed by the end of 2008. Remediation plans and watershed permits to implement the TMDLs are under development.
Erosion Control at Construction Sites			
	Conduct training for construction contractors and provide inter-agency coordination	In progress	Training sessions have been conducted in cooperation with the Agency of Transportation and the International Erosion Control Association.
	Improve permit review, enforcement, and compliance	In progress	All four additional staff positions identified in the TMDL to meet construction site erosion control needs have been filled, and these positions have been integrated into the DEC Stormwater Management Program. The increase in staff has allowed for regional staff coverage, allowing increased staff presence throughout the state for compliance and enforcement.
	Implement the Construction General Permit	Completed	The new, risk-based, Construction General Permit was issued in 2006, lowering the threshold of earth disturbance that requires permit coverage from five acres to one acre.
	Revise the Erosion Control Handbook	Completed	Three new technical documents were published in conjunction with the new Construction General Permit. These include a new set of technical standards for use by the consulting community, as well as two field guides designed to assist contractors and individual landowners in properly implementing best practices for erosion prevention and sediment control during construction. and the Vermont Erosion Prevention and Sediment Control Field Guide.
Better Backroads			
	Increase grant funds to towns	In progress	Grant funding to towns has been greatly increased.
	Increase staffing for grant administrative support for towns	In progress	A 50% position at the Northern Vermont Resource Conservation and development Council is funded to assist town with Better Backroads grant applications and administration.
	Add a circuit rider position for technical assistance to towns	In progress	One position at the Northern Vermont Resource Conservation and Development Council is funded to provide technical assistance to towns for Better Backroads projects.
	Conduct regional workshops	In progress	Several regional workshops per year have been conducted through the Better Backroads Program working with regional partners.

	Update publications	In progress	The Better Backroads Manual is currently undergoing revisions and updates with printing expected in 2008.
	Develop road AMPs	In progress	As part of the Better Backroads Manual update, Accepted Management Practices (AMPs) are being drafted for discussion with program partners.
	Conduct an equipment sharing pilot project	Completed	Groups of towns in both Lamoille County and Addison County jointly own and share hydroseeding equipment.
	Support ANR staff involvement	In progress	ANR staff involvement in the Vermont Better Backroads Program has continued.
Local Municipal Actions			
	Provide technical assistance to towns in developing local regulations for water quality protection	In progress	A water quality specialist is being funded by Clean and Clear at the Vermont League of Cities and Towns.
Wetland Protection and Restoration			
	Add position at ANR to support education and planning for wetland protection and restoration	In progress	A new wetland restoration specialist is working at the Department of Forests, Parks, and Recreation.
	Develop a Lake Champlain Basin Wetland Restoration Plan	In progress	The draft Lake Champlain Basin Wetland Restoration Plan was completed in early 2007. The final plan should be completed by the end of 2007.
	Implement the Lake Champlain Basin Wetland Restoration Plan	In progress	Several wetland restoration projects are in development using state capital funds appropriated for this purpose, in cooperation with other partner organizations.
	Develop and implement a wetland acquisition plan	No action	Clean and Clear funding has not been requested for this item.
St. Albans Bay			
	Conduct a feasibility study for the control of internal phosphorus loading in St. Albans Bay	In progress	Phase 1 of a two-phase feasibility study has been completed. ANR is evaluating the results of the Phase 1 study and will make a decision as to how to proceed with Phase 2 in late 2007.
	Conduct a treatment, if recommended by the feasibility study	No action	Specific decisions on a treatment will cannot be made until the Phase 2 feasibility study is complete.
Monitoring and Research			
	Continue the Lake Champlain Monitoring Program	In progress	Monitoring of the lake and its tributaries is continuing by Vermont DEC and New York State DEC with funding from the Lake Champlain Basin Program.
	Continue the Vermont Lay Monitoring Program	In progress	Monitoring of Lake Champlain and Vermont inland lakes by citizen volunteers is continuing with funding from Clean and Clear.
	Continue the operation of USGS stream flow gages in the Lake Champlain Basin	In progress	The USGS is continuing to operate the network of flow gages in the Lake Champlain Basin.
	Track agricultural BMP implementation	In progress	The Vermont Department of Agriculture, Food, and Markets tracks BMP implementation by watershed in Vermont.
	Conduct BMP effectiveness monitoring studies	In progress	Before and after monitoring of the effectiveness of urban stormwater controls in Englesby Brook in Burlington is continuing with laboratory services provided by Vermont DEC. A similar study on an agricultural site on Little Otter Creek in Ferrisburg had to be discontinued last year when the farmer declined to follow

			through with planned BMP implementation.
	Update Lake Champlain Basin land use and phosphorus export analysis	Completed	A report on a Lake Champlain Basin land use and phosphorus export study has been completed by the University of Vermont with Clean and Clear funding, and is in the final stages of technical review.
	Conduct research on phosphorus reductions expected from nonpoint source management actions	In progress	The ANR has awarded a grant for the first year of a phosphorus accounting project to be conducted by the University of Vermont.
Program Administration			
	Provide one staff position for general administrative support	In progress with expanded scope	Additional Information Technology staff, and administrative staff for DEC regional offices have been hired to support Clean and Clear related work not originally anticipated in the TMDL.
Agriculture			
	Accelerate the establishment and protection of riparian buffers on agricultural land	In Progress	The CREP program has enrolled approximately 1,500 acres in the Lake Champlain Basin and the momentum is currently very strong for the program. Two staff were hired at VAAFM which increased the program efforts significantly. In 2007 the Vermont Agricultural Buffer Program was released to provide a harvestable filter strip and grassed waterway option to help recycle nutrients on the farm and increase the use of soil erosion reduction practices.
	Accelerate the establishment of nutrient, crop and pesticide management services in the Basin	In Progress	Statewide more than 37,000 acres have been enrolled in the Nutrient Management Cost-Share Program at VAAFM with the majority located in the Champlain Basin. The Farm Agronomic Practices Program has also been developed to help implement practices that compliment a nutrient management plan
	Additional resources to conduct and target agricultural non-point source pollution outreach to farm operators in the Lake Champlain Basin	In Progress	VAAFM has increased staff resources in Franklin County by placing a position in the USDA service center and is currently in the process of hiring another.
	Continue LFO permitting	In Progress	The number of farms permitted has nearly doubled since the TMDL was developed, and the LFO rules were revised which included additional standards for nutrient management
	Create a permitting program for farms between 300 and 950 animal units	In Progress	The MFO rules were completed in 2007 and official permitting begins in August 2007. Three additional staff were hired to develop and implement this program.
	Implement more non-structural BMPs in the Basin and increase funding for all BMPs, structural and non-structural	In progress and expanding	An additional engineering technician was hired at VAAFM to educate farmers on composting techniques. The FAP program has provided cost-sharing for field practices that reduce erosion. The level of cost-sharing for livestock exclusion from streams has been increased to 80%. Overall BMP cost-sharing has been increased from 50% up to 80% on structural practices when no other assistance is available.
	Review the AAPs	Completed	The AAPs were revised in 2006 to include new streamside set back requirements, livestock disposal practices, streambank requirements, and nutrient management practices

Agency of Natural Resources
Clean and Clear Programs



Wastewater Discharges

The Problem

Phosphorus has been a concern in wastewater treatment because it has always been a part of the discharge flowing from treatment facilities. There are 60 wastewater treatment plants discharging phosphorus in the Vermont portion of the Lake Champlain Basin. These facilities include municipal and industrial plants and other facilities such as fish hatcheries. Wastewater discharges represent a regulated and readily measurable source of phosphorus to Lake Champlain.

The Program

Most of the phosphorus in wastewater effluent can be removed through advanced treatment processes. Vermont has been making capital investments to upgrade wastewater treatment facilities for phosphorus removal for many years. Between 1979 and 2001, before the Lake Champlain Phosphorus TMDL was adopted, 30 municipal facilities in the Lake Champlain Basin were upgraded for phosphorus removal at a capital cost of $39 million.

An advanced wastewater treatment facility.

State law limits the concentration of phosphorus in the effluent from larger facilities in the Lake Champlain and Lake Memphremagog basins to a monthly average of 0.8 milligrams per liter. In addition, the Lake Champlain Phosphorus TMDL established individual, annual mass loading limits (in metric tons per year) for phosphorus at each wastewater discharge in the basin. Compliance with the loading limits in the TMDL will require construction of phosphorus removal upgrades at five aerated lagoon type treatment plants. The state currently provides grants to municipalities for 100% of the capital cost of constructing needed phosphorus removal upgrades.

Program Accomplishments

Richford

This facility upgrade has been completed and became operational with phosphorus removal in September of 2006.

Troy/Jay

Planning for project implementation at the treatment facility (200,000 gal/day) started, but was suspended when area developers and the Jay Peak Ski Area indicated that development was being planned which would need additional capacity. Therefore, a planning effort has been undertaken to look at potential expansion of the facility to 800,000 gal/day. The project would become a combined upgrade (for permanent phosphorus removal) and enlargement project. In order to comply with their discharge permit, which required phosphorus removal implementation by September 30, 2006, the town installed interim phosphorus removal facilities which will serve to achieve their stricter permit limits until the facility enlargement project is undertaken.

Hardwick

This project, which includes an anaerobic reactor zone in the first lagoon as a pilot project to determine performance and operational benefits that may result, is substantially complete and in operation.

Waterbury

The village is in the preliminary engineering phase for this project. Their discharge permit requires implementation of phosphorus removal by December 31, 2007. It is possible this date will be extended to allow additional preliminary planning efforts as the municipality desires to expand the facility's organic capacity.

Proctor

The town is in the preliminary engineering phase for this project. Their discharge permit requires implementation of phosphorus removal by December 31, 2009.

Aerated Lagoon Wastewater Phosphorus Removal Projects in the Lake Champlain Basin

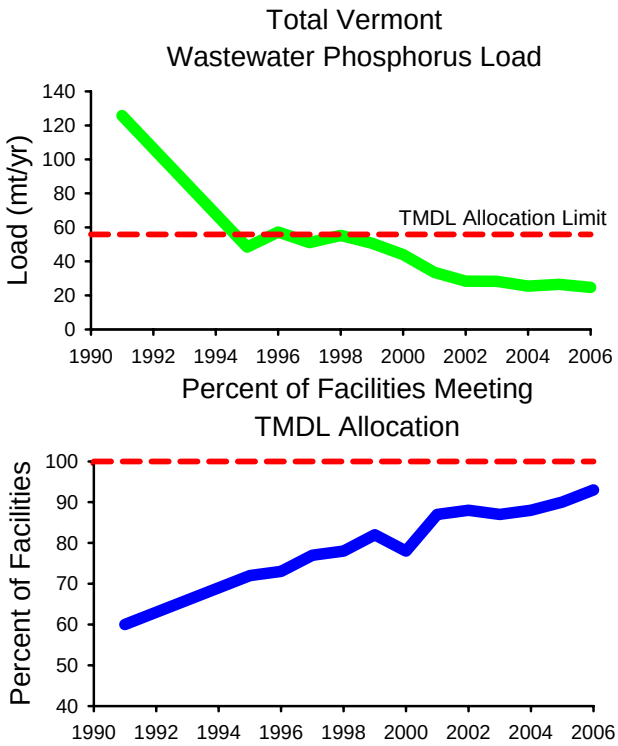
Facility	Estimated Capital Cost	Phosphorus Reduction (mt/yr)[1]	State Fiscal Year of Funding[2]
Richford	$690,000	2.20	2005/2006
Troy/Jay	$500,000	1.16	2005
Hardwick	$850,000	2.15	20072008
Waterbury	$500,000	2.96	2007
Proctor	$600,000	1.89	2008/2009
TOTAL	**$3,140,000**	**10.36**	

[1]Reduction in permitted load (metric tons per year).
[2]Year of actual or proposed appropriation.

Indicators of Progress

As a result of these past investments, phosphorus loading to Lake Champlain from Vermont treatment plants has declined by 80% since 1991. The total wastewater discharge of phosphorus from Vermont is now below the overall TMDL limit of 55.8 metric tons per year, largely because of the improved treatment, but also because most of these facilities are operating below their capacity.

Vermont's long-term program to reduce wastewater discharges of phosphorus to Lake Champlain represents a major success story. All but four of Vermont's 60 facilities in the basin achieved their annual TMDL wasteload allocations during 2006, and two of those four have since become operational with the necessary phosphorus removal treatment. During the 1970s, wastewater discharges made up nearly half of the total phosphorus load to Lake Champlain. Recent river monitoring data indicate that wastewater discharges are now less than 10% of the total load to the lake.



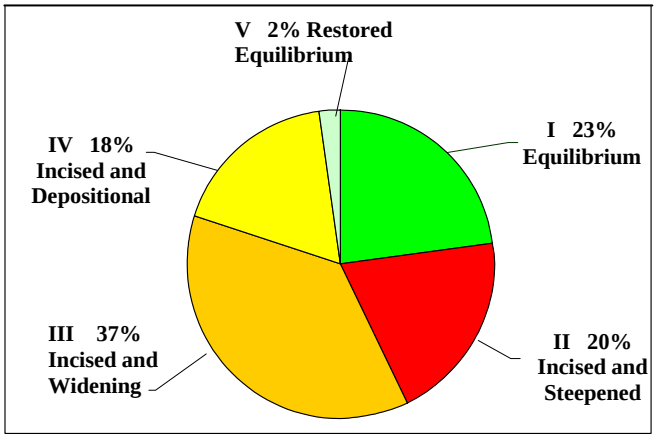
River Management

The Problem

Since European settlement, repeated watershed and stream channel modification (i.e., deforestation, ditching, dredging and armoring) has led to a widespread loss of floodplain function throughout Vermont. Rivers, now confined to deeper, straighter channels, do not have access to their historic floodplains. The increased power of larger floods, contained within the channel, has led to higher rates of bed and bank erosion. With erosion hazards and flood losses increasing, methods to keep rivers disconnected from their floodplains and static in the landscape have become unsustainable. Aside from the financial impact of erosion hazards and flood losses, another significant consequence of stream alterations and encroachments has been a profound loss of sediment, nutrient storage, and attenuation capacity within the State's river corridors. If phosphorus is not retained within the river channels and flood plains throughout the watershed, it is transported downstream to receiving waters like Lake Champlain. Alternatively, if the phosphorus is captured and retained on floodplains, it can feed and grow plants and crops in the open space and agricultural meadows rather than in the bays of Lake Champlain.

The extent and scale of the historic physical manipulation and constraint of rivers is almost incomprehensible because these changes are so pervasive, began over 200 years ago, and are only now being documented scientifically. The profound loss, due to channelization, drainage works, and flood plain encroachments, of sediment and nutrient storage functions at a watershed scale has resulted in an increase in fluvial erosion hazards (i.e., flood and erosion damage), and an upward trend in sediment, soil, and nutrient export from Vermont watersheds. River management has become a vicious cycle where flood recovery and structural constraints (i.e., channel straightening, berming and rip-rapping) have led to developments along rivers where they formerly meandered and flooded. Inevitably, and often decades later, a large flood occurs, structures fail, and the cycle repeats itself. As the economic, social, and environmental costs increase, the adoption of sound, science-based river management practices will be imperative. This requires an increased level of public understanding about river processes and changes in individual and community relationships with fluvial systems.

Rivers that have down cut and lost access to their floodplains will erode their banks until new floodplains are formed. During the early stages of this channel evolution process, floods remain within deepened channels, and have much more power to erode and carry away anything that enters them. Without floodplains and meanders, it is often the lakes and reservoirs that are the first quiet waters in which rivers deposit the eroded soil and nutrient. This process helps to explain the increasing enrichment and algae along the shores and bays of Lake Champlain. As shown in the chart, 75% of the 980 field



Stream geomorphic assessment results (2002-2007).

stream miles assessed by the RMP are in unstable condition (stages II-IV) of the evolution process. Lacking floodplain access, they do not provide the sediment and nutrient storage function that they would if in equilibrium. The Clean and Clear goal of achieving stream stability to benefit the lake is now being aggressively pursued through landowner and municipal incentives to protect and restore stream equilibrium. Protection and restoration of floodplains are essential to stable streams and sustainable water quality management.

Program Accomplishments

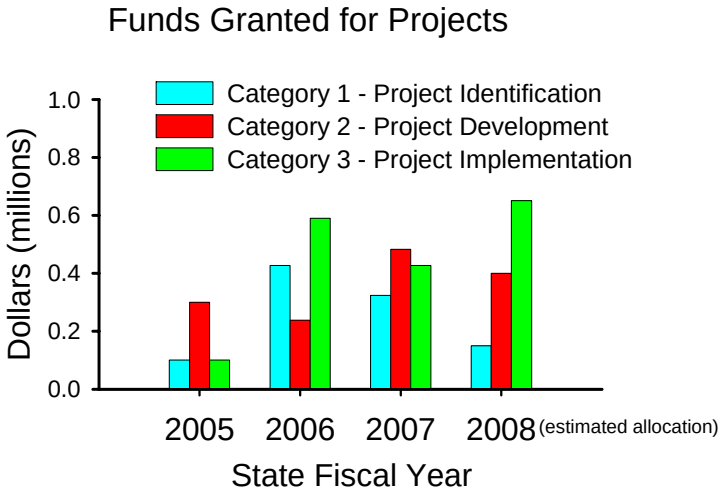
River Corridor Grants

The goal of river management in Vermont is to protect and restore our streams and riparian corridors based on the science of fluvial geomorphology. This science-based river management approach involves elements of technical assessment, river corridor protection, management of existing human conflicts with river processes, restoration of unstable reaches, and education of landowners and public officials about these principles. The great majority of this work is achieved by supporting partners through River Corridor Grants.

During 2007, a River Corridor Planning Guide was produced to provide detailed guidance for identifying technically and socially feasible projects. The Guide is used to develop watershed scale stressor and sediment regime departure maps to evaluate and set priorities for projects that will maximize stream equilibrium conditions and sediment/nutrient attenuation. See a copy of the guide at: http://www.anr.state.vt.us/dec/waterq/rivers/docs/rv_rivercorridorguide.pdf

The River Management Program (RMP) provides technical assistance and grants to a variety of watershed organizations to pursue a sequence of (1) river assessment and project identification, (2) project development, and (3) project implementation (Category 1, 2, and 3 River Corridor Grants respectively), all based on fluvial geomorphic principles. River Corridor Grants also provide assistance and incentives for communities to adopt and support local actions such as growth and development decisions that take into account the geomorphic processes of surrounding streams. Through technical assistance grants, the RMP is building partnerships to work toward restoration and protection of floodplain function and channel equilibrium.

Category 1 grants support river assessments conducted through a two-phase stream geomorphic assessment process in order to understand observed problems and identify remediation opportunities within a larger watershed context . This is done using nationally recognized and peer-reviewed protocols developed by the Vermont DEC River Management Program.



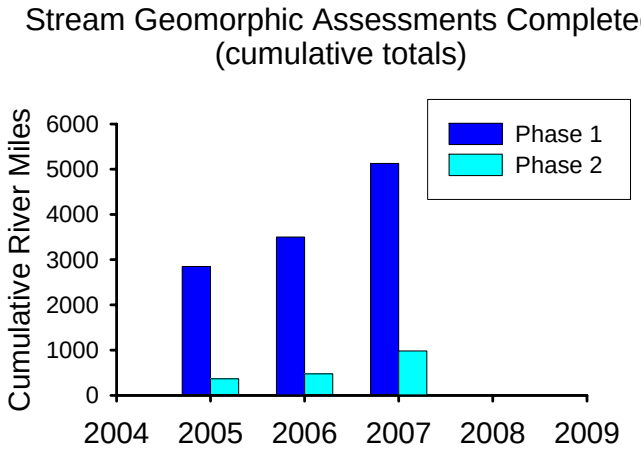
Category 2 grants support the creation of: river corridor management plans, fluvial erosion hazard maps and corridor

restoration and protection project designs to address channel instability in a holistic, technically sound, and socially feasible manner. Category three grants fund project implementation. Project categories include: river corridor protection through either zoning or conservation easements, river and/or floodplain restoration to restore hydrologic, sediment and nutrient attenuation capacity, and encroachment removal to eliminate existing sediment transport barriers such as undersized culverts.

In fiscal year 2008 a total of $1.2 million dollars in capital funds was made available competitively through the River Corridor Grant Program. Of this total we hope to award approximately $150,000 toward Project Identification grants (Category 1), $400,000 for Project Development grants (Category 2), and $650,000 towards Project Implementation grants (Category 3). These funds will sponsor river corridor projects throughout the State.

Stream Geomorphic Assessments (Category 1 Grants)

Phase 1 geomorphic assessments have been completed on 5,129 river miles in the Lake Champlain Basin since 2004. These assessments help tell the initial story of the physical state of a waterway, and are completed using resources such as orthophotos, topographic maps, geographic information systems (GIS), and quick observation surveys.



Phase 2 stream geomorphic assessment data provide a reach-specific analysis of the current geomorphic state of a river. Quantitative and qualitative data are collected in the field using protocols created by the River Management Program to assess physical habitat and geomorphic departure and sensitivity. These "on-the-ground" observations have been completed on 980 river miles throughout the state since 2004. A map-based web page providing database access is at: http://maps.vermont.gov/imf/sites/ANR_SGAT_RiversDMS/jsp/launch.jsp?popup_blocked=true

Project Identification and Development (Category 2 Grants)

The development of geomorphic assessment-based corridor management plans is occurring throughout the state. Corridor management planning provides the opportunity to use geomorphic assessment data and consider local constraints to identify and prioritize technically and socially feasible corridor protection and restoration projects. See a complete list of river corridor plans at: http://www.anr.state.vt.us/dec/waterq/rivers/docs/FinalReports/rv_projectreportlist.pdf

Corridor Protection and Restoration (Category 3 Grants)

The 2007 funding has been used to support several river corridor protection and restoration projects throughout the State. These projects include both active channel and floodplain restoration and river corridor protection through zoning and conservation easements. The objectives of both corridor protection and restoration projects include: reduction of flooding and channel erosion, capture of suspended sediment and nutrients, and improved riparian and in-

stream habitat. The River Management Program is working to dramatically increase the number of corridor protection and restoration efforts in place throughout the state. Several corridor protection and restoration projects supported by 2007 funding are highlighted below.

Lamoille Valley Rail Trail Flood Plain Restoration Update

The degradation of Lake Champlain water quality, caused by the flow of nutrient rich sediment into Missisquoi Bay, has focused attention throughout the watershed on the contributors to this dramatic ecological response to human land use. Watershed and stream assessments have identified widespread stream channelization and extensive flood plain encroachments created by roads, railroads, and other land uses as significant contributors to profoundly diminished sediment storage and nutrient attenuation capacity of flood plains and river corridors.

Lamoille Valley Rail Trail segment showing completed flood plain restoration.

Last year's Annual Report introduced the Lamoille Valley Rail Trail project being implemented on the state-owned Lamoille Valley Railroad. The existing rail bed is being converted to a four season recreation trail under the sponsorship of the Vermont Association of Snow Travelers (VAST). Since the1800s when the rail line was constructed along the Lamoille River, Black Creek and the Missisquoi River, thousands of feet of river channel were channelized and bermed, effectively isolating hundreds of acres of historic flood plain. The current use conversion has presented the unique opportunity to reconnect these rivers to their historic flood plains for the first time in over one hundred years.

Location of Lamoille Valley Rail Trail Floodplain Restoration Projects

Site	Length (ft)	Floodplain (ac)
Wolcott	1,338	7
Bakersfield #1	1,723	34
Bakersfield #2	1,137	5
Fairfield #1	1,476	5
Fairfield #2	567	4
Johnson	2,315	15
Cambridge	3,795	50
Fletcher	1,454	10
Fairfield #3	2,260	10
Fairfield #4	2,445	36
Totals	**18,510**	**176**

To take advantage of this opportunity, the Vermont Agencies of Natural Resources and Transportation, the USDA Natural Resource Conservation Service, and the Lamoille and Franklin County Natural Resource Conservation Districts are collaborating to implement a series of ten floodplain restoration projects. Upon completion, over 3 ½ miles of rail bed will be removed allowing the river to reconnect with 176 acres of historic floodplain.

Wanzer Brook Flood Plain Restoration

The Wanzer Brook project is located on the Boomhower Farm in the Town of Fairfield Vermont. The overall goal of the project was to restore natural river characteristics and processes and ecological health of the Wanzer brook corridor while at the same time protecting valuable agricultural resources. Starting with the results of the Wanzer Brook stream geomorphic assessments, project objectives were developed in collaboration with project partners USDA

Natural Resource Conservation Service and the U.S. Fish and Wildlife to include active floodplain reconfiguration, channel armoring, construction of animal crossings and fencing, establishment of healthy riparian vegetation, and conveyance of all channel management rights within the corridor.

Wanzer Brook Pre-Construction.

Restoration of the natural fluvial processes occurred though enhancement of floodplain function. Excavation of the currently abandoned floodplain lowered the floodplain surface to the elevation of the 2-year flow of Wanzer brook thereby increasing the frequency of over bank flows. In total, approximately 1.5 acres of abandoned floodplain was lowered approximately 2 feet, resulting in a total cut volume of 6,000 cubic yards. Excavated topsoil was stockpiled on-site and reapplied to the floodplain following excavation. This provided a good substrate within which riparian planting will occur in the spring of 2008.

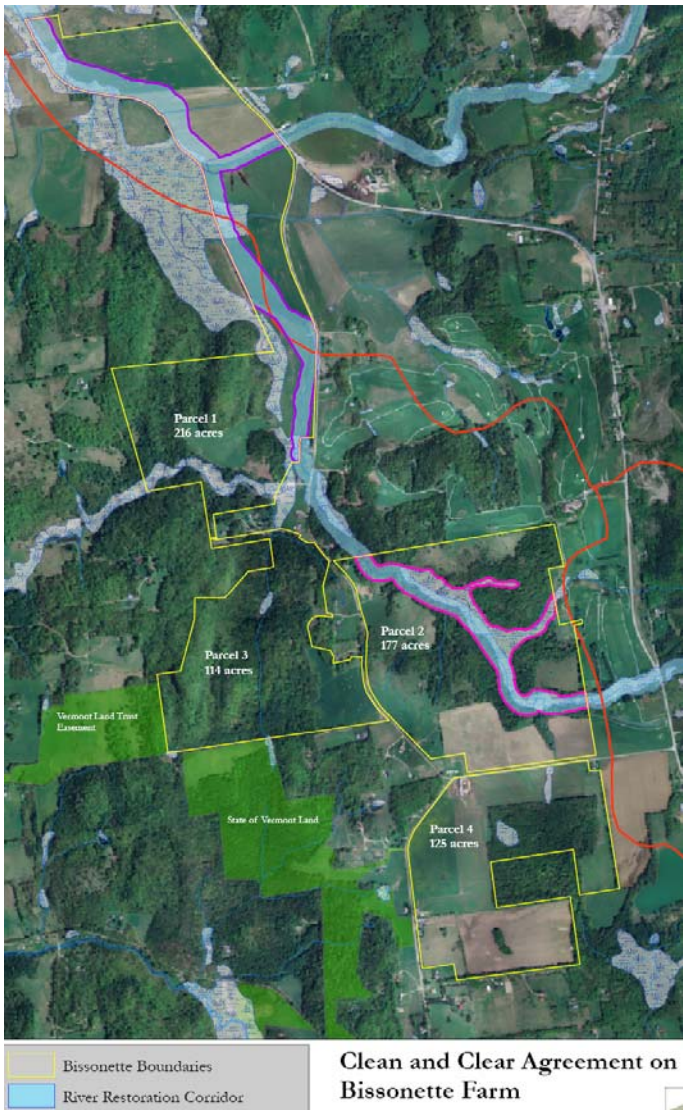
The project also established an easement to purchase the channel management rights within the belt width corridor to allow the brook to obtain an equilibrium condition. An overlay to an existing easement on the farm held by the Vermont Land Trust, The Vermont Agency of Agriculture and Food and Markets, and the Vermont Housing and Conservation Board will be made to include the conveyance of channel management rights within the corridor from the landowners to the easement co-holders. This will preclude any future management of the brook inconsistent with equilibrium conditions and ensure that the river is free to adjust within the river corridor in perpetuity.

Wanzer Brook Post-Restoration.

Critical to the success of the project is a sound riparian revegetation and fencing plan that will result in a healthy riparian flora community. At the floodplain surface, healthy riparian vegetation will create roughness that will slow over bank flows leading to a deposition of sediment and nutrients on the floodplain and prevention of excessive floodplain scour. Healthy riparian vegetation will also provide shading which will help minimize water temperatures, and leaf litter which will serve as an energy input to the aquatic ecosystem. Terrestrial wildlife will also benefit from the feed and cover values provided by a healthy riparian community.

River Corridor Protection Easement - LaPlatte Headwaters Initiative

After three years of planning, the Hinesburg Land Trust, in partnership with the Trust for Public Land and the Vermont Land Trust, has closed on a deal to conserve the 627-acre Bissonette Farm property in Hinesburg. The property will be conserved for a variety of uses including wetland restoration, river and river corridor protection, farming, recreation and wildlife protection.



Clean and Clear Agreement on Bissonette Farm

The Hinesburg Land Trust received $220,000 in Clean and Clear funding from the state for this project. This money was used to purchase land that will be used for a large-scale wetland restoration and river and river corridor protection project.

Channel management restrictions have been placed along 7,500 feet of the LaPlatte River and 68 acres of adjacent river corridor has been conserved. This river and floodplain protection and restoration effort will help improve sediment and nutrient attenuation in the LaPlatte River and its adjacent floodplain, which flows into Lake Champlain. This project is the first wetland restoration and river corridor protection easement under the Clean and Clear initiative.

Flood Plain Management

Regulation of development in flood plains is the responsibility of municipalities enrolled in the National Flood Insurance Program (NFIP) and overseen by the office of the Vermont NFIP Coordinator within the River Management Program. Most local government land use regulations do not exceed the minimum standards of the NFIP and therefore are generally not consistent with or supportive of Clean and Clear Action Plan objectives. This is because the minimum standards allow flood plains to be filled and encroached upon, creating the opportunity for human investments to come into conflict with fluvial processes. For example, these regulations allow people to build a house or other structure in a flood plain that will eventually be flooded. Flood plains are vital features of the riparian corridor within which sediment and phosphorus are captured and retained, rather than transported downstream.

A portion of the Clean and Clear River Management Program FY 08 operating budget has been earmarked for a temporary position in support of efforts to work with local governments wishing to better protect the sediment and nutrient attenuation capacity of flood plains in their communities. During the last six-month FEMA reporting period, the Community Assistance Program (CAP) responded to 756 e-mails and 765 phone calls from Vermont municipalities seeking assistance with NFIP related projects or program administration. Of these inquiries, the program completed reviews and commented on 59 specific projects being proposed in flood hazard areas around the state.

Fluvial Erosion Hazard Mapping

Avoiding conflict between people and rivers is essential to managing river systems in an economically and ecologically sustainable way. Fluvial erosion hazard mapping is a key component of the River Management Program's ongoing efforts to avoid fluvial conflicts. This is being accomplished by working with towns throughout the state (61 at present) to identify, understand, and map fluvial erosion hazards and to support the implementation of planning and zoning strategies informed by these maps. The adoption of zoning regulations limiting encroachment in stream corridors sensitive to fluvial erosion is an essential fluvial erosion hazard mitigation activity which enables streams to be managed toward their equilibrium condition. Because stream bank and channel sediment is a major source of phosphorus, managing streams toward an equilibrium condition will reduce phosphorus loading to Lake Champlain by minimizing fluvial erosion and protecting essential sediment (and phosphorus) attenuation features.

Fluvial Erosion Hazard Activities Underway	**Number of Towns**
Maps adopted	2
Projects underway	36
Preliminary outreach conducted	11
Geomorphic assessments underway specifically to support fluvial erosion hazard zone development	12
TOTAL	**61**

The River Management Program used state Clean and Clear funds to leverage FEMA Pre-Disaster Mitigation (PDM) grants in 2007. These funds are being used to partner with Regional Planning Commissions to work with towns to map erosion hazards and support mitigation activities, including planning and zoning. PDM activities are underway at ten Regional Planning Commissions including six within the Lake Champlain Basin. The extensive fluvial erosion hazard mapping made possible through PDM funding has greatly expanded the number of towns working on planning and zoning activities which further Clean and Clear goals and objectives.

To date, fluvial erosion hazard maps have been developed for the towns of Stowe, Middlesex, Lincoln, and Cabot, Strafford, Hinesburg, Huntington, Brattleboro, and Castleton. In addition, fluvial erosion hazard map development at a watershed level is underway in Allen, Winooski (Marshfield). West Branch Little River, Mad River, Tweed River, Upper White River, Alder Branch, and La Platte.

Stream Alteration Regulation

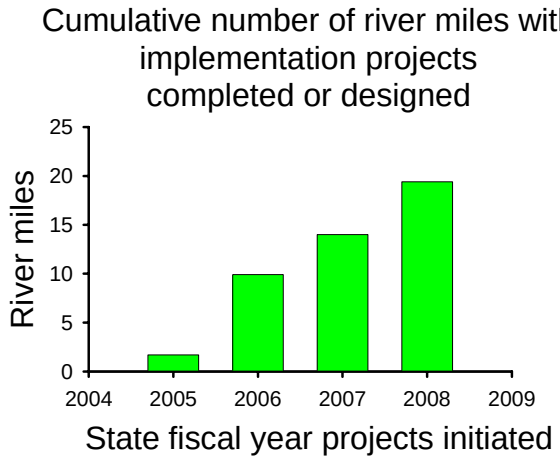
During the eight month construction season, regional River Management Engineers average 1,000 phone calls regarding stream alterations, 500 site visits, and 150 permits – including stream alteration permits, 401 water quality certifications (for small stream crossings), Title 19 permits (highways), Act 250, and gravel extraction permits.

Most of the 850 calls or site visits where no permit or certificate is issued result in an opportunity to educate the public or town official about the state's river management objectives. When done in the context of a landowner's specific issue, there is a tremendous benefit to the state in the actions or inactions they decide to take.

One of the three regional engineers is in a Clean and Clear funded position. This position has resulted in an increase in regulatory review. Landowners, town officials, and agency personnel have become aware of the program's presence and that a River Engineer will follow up on activities both with respect to providing service and following through on compliance issues. Prior to having the Clean and Clear position, with only two engineers covering half the state, it was not possible to make it to every site or have the time to spend on the phone, therefore, regulatory compliance was lower, as people went ahead with stream alterations without seeking the State's review.

Indicators of Progress

Since the start of the Clean and Clear Action Plan in 2004, the River Management Program (RMP) and its partners have assessed 6,100 miles of stream. River assessments support the identification, development, and implementation of river corridor projects that will reduce phosphorus loads entering Lake Champlain. The results of these river assessments are telling the recurring story that agricultural, residential, and transportation land use investments and encroachments in river corridors, and the channel management activities made necessary to protect these investments, have led to the straightening, armoring, steepening, and accelerated down-cutting of rivers into the landscape.



The RMP is focusing on the restoration and protection of floodplain function and stream equilibrium as the most cost effective and enduring strategy for minimizing soil erosion, flood and fluvial erosion hazards, and phosphorus production. In the first year of the River Corridor Grant program, emphasis was placed on geomorphic assessment to gather and analyze data to help identify potential river corridor restoration and protection projects. In the following years, the data from these initial and on-going assessments has enabled the completion of eight river corridor plans. With technically and socially feasible projects identified, the RMP has been able to focus an increasing portion of funds on project implementation. So far, the RMP has used the assessment process to identify, develop, and implement corridor protection and restoration projects covering

approximately 19 river miles across the state. Because every completed plan represents several feasible projects and more and more plans are being completed each year the proposals for protection and restoration project implementation is increasing dramatically.

Successful protection and restoration of river corridors in Vermont starts with education and collaboration with landowners, communities, and other state and federal agencies. The RMP places a very high priority education, making an average of two public presentations a week to inform the public and partners about science-based river corridor protection and restoration. A considerable educational effort is required to demonstrate that river corridor protection aligns with and supports long-term protection of agricultural productivity, forest resources, recreational opportunities, and fish and wildlife habitats. But the Agency of Natural Resources and the RMP cannot do it alone - it is imperative that we collaborate with local governments, landowners, organizations, the legislature, and other agencies to successfully work towards the protection and restoration of Vermont's river corridors.

While active restoration projects may restore equilibrium conditions to a section of river and serve as important demonstrations of potential solutions, these active restoration projects affect only a tiny percentage of the systemic problems. For every mile of river corridor restored, there may be several additional miles suffering new encroachments. Rivers and streams need space, a "river corridor," to express their physical imperatives and that will accommodate the fluvial equilibrium condition. This not only minimizes the production and export of sediment and phosphorus, but also avoids flood and fluvial erosion hazards, and maximizes the sustainable social, economic, and ecological functions of rivers for Vermont's communities and individuals.

While we will continue to develop and implement active river corridor restoration projects, the highest priority of the RMP is to work with individuals, local governments, state and federal agencies, and land and resource conservation organizations to permanently protect river corridors so that their sediment, nutrient, flood, and erosion attenuation functions can be either retained or restored over time without expensive human interventions. This strategy is critically important given the current and impending high rate of land use conversion in Vermont.

Better Backroads

The Problem

The backroads of Vermont are integral to the state's rural image and quiet, tranquil nature. Hidden from view is the fact that these rural roads, whether gravel or paved, can be a significant source of phosphorus if they are not properly maintained. The Better Backroads Program enables towns to fix chronic erosion problems in an optimal way so they can avoid annual repairs and reduce phosphorus and sediment pollution.

Roadside drainage ditches and culverts become part of the stream network during rainstorms or snowmelt events. Sediment eroding from road surfaces and ditches washes into the drainage network and delivers phosphorus that is transported downstream, eventually to Lake Champlain, Lake Memphremagog, the Connecticut River or the Hudson River. With an average of 46 miles of backroads per town, the impact can be significant.

The Program

Proper correction of these roadside erosion problems has the dual benefit of reducing long-term road maintenance costs while protecting water quality. Our goal is to provide sufficient administrative assistance, technical support, and grant funding to eventually involve all Vermont towns in the program. Financial and technical support demonstrates to towns that the proper fix pays for itself in a few years, increasing the likelihood that towns will implement such projects on their own.

A steep roadside ditch in Fletcher was stabilized in 2007.

The Vermont Better Backroads Program started in 1997. It provides grants and technical assistance for towns to correct erosion problems and to adopt road maintenance practices that protect water quality while reducing long-term highway maintenance costs. It is a partnership formed with the Vermont Local Roads Program, the Vermont Agency of Transportation, the Vermont Agency of Natural Resources, and the Northern Vermont and the George D. Aiken Resource Conservation and Development Councils. The program is administered by the Northern Vermont Resource Conservation and Development Council. The Clean and Clear Action Plan significantly enhanced this program beginning in 2004, by adding staff for grants management and technical assistance and by increasing the dollar amounts available for grants.

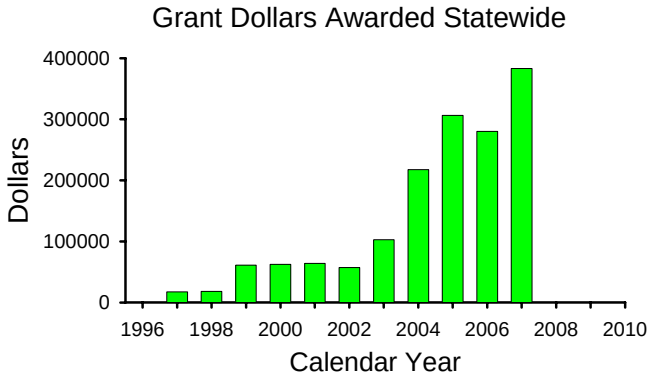
The road maintenance practices advocated by the Better Backroads Program are typically cost-effective in the long run. The one-time investment to fix a chronic erosion problem properly (e.g., rock-line a steep roadside ditch) generally pays for itself many times over in reduced long-term maintenance costs. The modest grants provided by the Better Backroads Program also demonstrate the benefits of recommended maintenance practices to local road commissioners and enable them to garner support for additional projects. It has been our experience that most towns adopt the recommended practices for all their road maintenance work, so that the grants we provide can leverage their cost in improved maintenance practices that will both reduce pollution and save towns money in the future.

Vermont Youth Conservation Corps crews were employed in three towns during 2007 to accomplish manual labor associated with some Backroads Projects. Here the crew hand places rock on a road/stream bank in the town of Norwich.

The Better Backroads Program offers improved infrastructure and maintenance practices for eroding ditches, unstable culvert inlets or outlets, and eroding roadside banks which can also help prevent flash flood damage during heavy rain events. Grants are provided for two general categories of projects including (A) developing a town-wide inventory of erosion control needs and a capital budget plan to address these needs, and (B) correcting existing erosion control problems.

Program Accomplishments

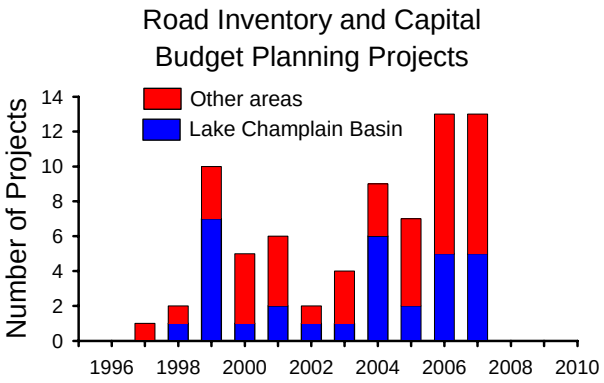
A total of 140 Vermont towns have participated in the Better Backroads Program since 1997 by conducting at least one grant-funded project, including 81 towns in the Lake Champlain Basin. In 2007, 22 new towns received grants through the program. Since the addition of significantly increased funding from Clean and Clear in 2004, participation by Vermont towns has more than doubled from 26% to 56%. In addition, substantial efforts were made by the Backroads Technician to contact towns in the Lake Champlain Basin that have not participated so far to encourage them to apply for a grant.

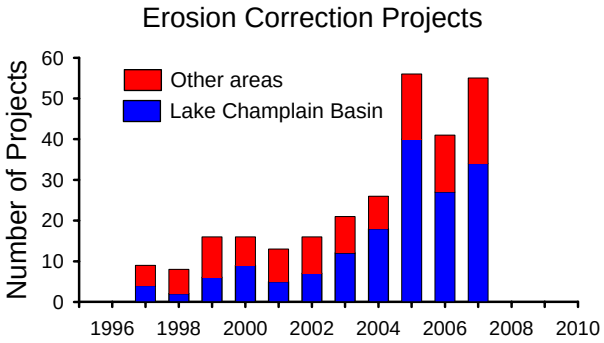


In addition to municipal projects, 24 non-municipal organizations have received grants since 1997; in 2007 six new organizations received grants. This funding has enabled such projects as private road erosion corrections, road erosion inventories conducted by lake or river associations or a regional planning commission, and the purchase and promotion of a hydroseeder whose use is shared among towns in a region.

During 2007 the Backroads Program continued cooperation with the Vermont Youth Conservation Corps. Manual labor supplied by the VYCC was used to implement certain aspects of projects in Benson, Lincoln and Norwich. Using Clean and Clear funding supplied through the DEC Rivers Management Program, VYCC crews assisted with projects involving substantial manual labor.

In 2007 the Backroads Program underwent a transition from a spring application period to a fall one. A spring period did not provide adequate review time to allow implementation in that same field season. It is anticipated that a fall application period will allow projects funded by federal monies (the majority of projects) to undergo review at VTrans and Federal Highways Administration over the winter and be approved for construction the following field season. Grants were offered in both seasons in 2007 (the funding split between them) and beginning in 2008 only a fall application period will be offered.





In 2004, the program began annual tracking (by calendar year) of phosphorus reduction indicators such as the total length of road ditches, number of culverts, and area of eroding road bank stabilized by Better Backroads projects. We now have four years of such data.

Through on-site technical assistance, publications, and participation in workshops, the Better Backroads Program is able to provide information on a wide variety of techniques that towns can use to reduce sediment and phosphorus loading to waters, while at the same time protecting the investment a town has in the roads.

FY 2008 Category A Grants – Road Inventory and Capital Budget Plan
(* indicates towns or organizations new to the program in 2007)

Town/Organization	**Project Name and Description**	**Awarded $**
Town of Addison*	Road Surface Mgt System - Inventory	$1,500.00
Town of Stockbridge*	Culvert Inventory & Assessment	$4,000.00
Town of Thetford	Thetford Culvert & Bridge Review	$4,000.00
Town of Benson	Road Erosion Assessment	$3,225.00
Town of Moretown	Inventory & Evaluation of Moretown riverbanks along Class 2 & 3 roads	$3,975.00
Town of Waitsfield*	Waitsfield Road Erosion Inventory & Capital Budget	$4,000.00
Town of Leicester*	Jerusalem/Hooker Rd Inventory/Planning for Improvements	$2,000.00
Southern Windsor Co	Weathersfield Rd Inventory & Capital Budget	$4,000.00

RPC*		
Town of Granville*	Granville Culvert & Bridge Assessment	$3,300.00
Town of Dummerston*	Road Inventory & Capital Budget Development for Crosby Brook Watershed Roads	$4,000.00
Town of Pittsfield	Culvert & Bridge Inventory & Assessment	$3,250.00
Two Rivers-Ottauquechee Regional Commission*	Town of Hartland Transportation Plan	$4,000.00
Town of Norton*	Norton Erosion & Water Improvement Project	$2,000.00
TOTAL		**$43,250.00**

FY 2008 Category B Grants – Correction of a Road Erosion Problem

(* indicates towns or organizations new to the program in 2007)

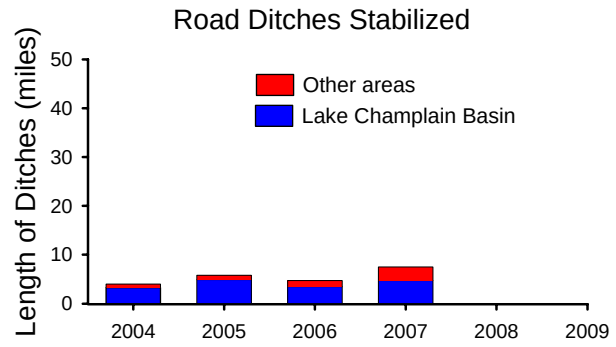
Town/Organization	**Project Name and Description**	**Awarded $**
All Souls Unitarian Universalist Church	All Souls Church West Village Meeting House Road Runoff Mitigation Project	$4,300.00
West Shore Road Assn-Lake Groton	West Shore Road Erosion Control Project	$2,981.25
Maidstone Lake Campowners Assn	West Side Road Stabilization Projects	$7,000.00
Spring Lake Ranch Inc*	Spring Lake Rd Improvement Project - road erosion	$4,750.00
Winooski Natural Resources Conservation District*	Oak Hill Stormwater Mitigation Project - roadside streambank stabilization	$7,000.00
UVM Extension Service	Bishop Street Erosion Control Project	$6,816.00
Town of Belvidere	Florence Rd - Roadway Erosion Improvement	$2,111.00
Town of Belvidere	Bog Road Drainage Improvements	$2,647.00
Town of Benson	North Lake Road Erosion Project	$7,000.00
Town of Bloomfield	Spencer Hill Erosion Control Project	$7,000.00
Town of Bridgewater	Perkins Road Ditch Stabilization Project	$3,769.00
Town of Bristol	Upper Notch Road Bank Stabilization	$7,000.00
Town of Cambridge	Bryce Rd (TH43) Project #1-roadside ditch is undercutting & eroding	$7,000.00
Town of Cornwall	West St - ditches	$4,650.00
Town of Corinth	Brook Road Erosion Control	$7,000.00
Town of Danville	Old Stagecoach Road Culvert Erosion Project - eroded road into stream	$4,000.00
Town of Danville	Morrill Road Erosion Control Project	$7,000.00
Town of Dummerston	Stickney Brook Road Erosion Project	$7,000.00
Town of Eden	Paranto Rd Drainage & Erosion Control - little or no drainage	$7,000.00
Town of Fairfield	Fairfield - Ridge Rd – stabilize eroding ditches	$7,000.00
Town of Glover	Daniels Pond Rd Erosion Control Project - insufficient ditches, water runoff	$7,000.00

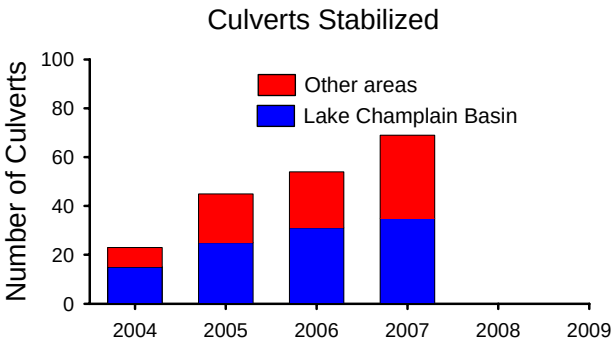
Town of Greensboro	Ditch Stabilization Project - inadequate ditches causing sediment to flow into Caspian Lake	$7,000.00
Town of Leicester*	Old Jerusalem Rd Stab Project - shoulders crumbling & falling into Otter Creek	$7,000.00
Town of Lincoln	York Hill Road Ditch Stabilization	$7,000.00
Town of Ludlow	Lower East Lake Rd- road runoff shoreline	$5,237.50
Town of Ludlow	Upper East Lake Road eroding the road surface	$6,505.88
Town of Middletown Springs*	Coy Hill Rd - ditches filled & overgrown & rusted culverts	$7,000.00
Town of Moretown	Dickerson Road Bank Stabilization	$6,930.00
Town of New Haven	River Road Erosion Control Project	$7,000.00
Town of North Hero	Pelot Point Road Project - eroding road slope & embankment	$7,000.00
Town of North Hero	Lake View Drive Lakeshore Erosion Control Project	$7,000.00
Town of Norton	Brousseau Mountain Road Erosion Control	$7,000.00
Town of Panton	Adams Ferry Road. - Ditch Erosion Stabilization	$7,000.00
Town of Pawlet	TH27 Stabilization Project	$7,000.00
Town of Pawlet	TH 14 Ditch Stabilization	$7,000.00
Town of Randolph	North Randolph Road/Stream Bank Stabilization	$7,000.00
Town of Richford*	South Richford Road Ditch Stabilization Project	$7,000.00
Town of Ripton	Barker Road Erosion Control	$7,000.00
Town of Rochester	Bingo Road Embankment Stabilization	$7,000.00
Town of Rutland*	Sand Hill Ditch Project - 500' eroded ditch along the road	$5,965.10
Town of Sheldon*	Kane Road Ditch Project	$7,000.00
Town of Sheldon	Sheldon/ St Marie's Hill Road Ditch Stabilization (funded by Supplemental Environmental Funds)	&7000.00
Town of Shoreham	Lake Street Ditch and Road Stabilization	$7,000.00
Town of Stratton	Pike Falls Road Erosion Control	$4,540.12
Town of Sunderland*	Bentley Hill Ditch Stabilization	$1,900.50
Town of Swanton*	Woods Hill Road Ditch Stabilization (funded by Supplemental Environmental Funds)	$7000.00
Town of Tinmouth	Palmer Brook Road Bank Stabilization	$7,000.00
Town of Victory	Masten Road Erosion Control Project	$7,000.00
Town of Waitsfield*	Dana Hill Rd Erosion Restoration Project	$6,946.00
Town of Walden	Baily-Hazen Road Ditch and Culvert Stabilization	$7,000.00
Town of Wardsboro*	South Wardsboro Road	$3,750.00
Town of West Haven*	Replace culverts on West Haven Main Rd East of Hubbardton River	$7,000.00
Town of Westford	TH#30 Pettengill Rd, Backslope Stabilization	$7,000.00
Town of Fletcher*	Rugg Road Erosion Control Project	$5,791.00
Town of Woodbury*	Greenwood Lake Bank Stabilization	$4,367.00
TOTAL		**$339,957.85**

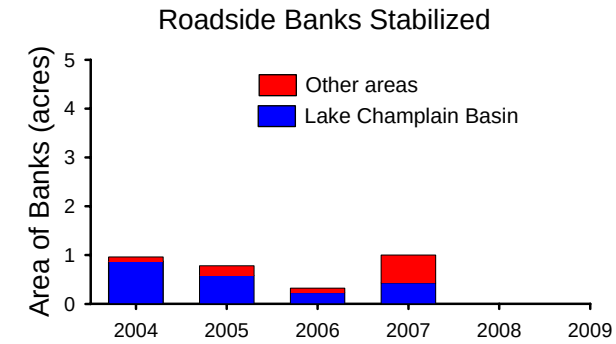
Indicators of Progress

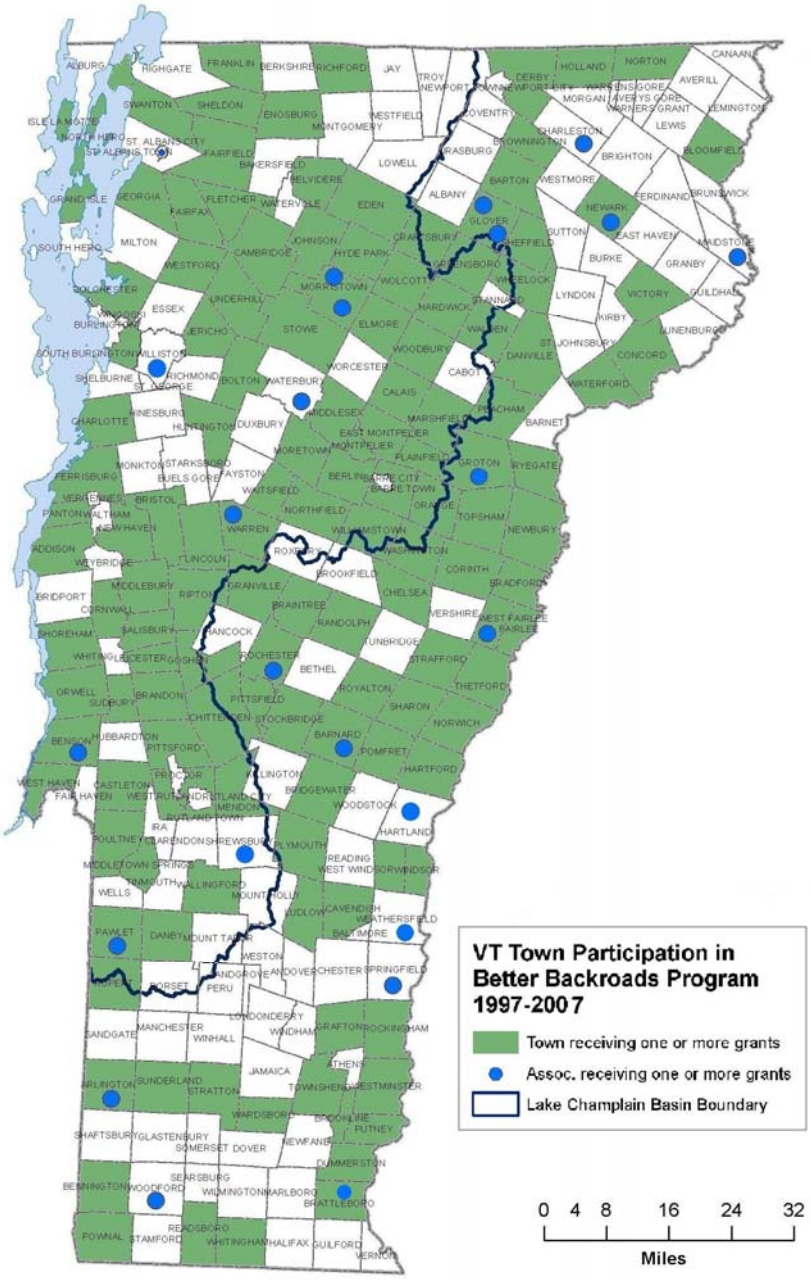
The Vermont Better Backroads Program is growing, with 47 new towns participating with Clean and Clear funding between FY 2005 and FY 2008. Statewide, however, only 56% of Vermont towns have applied for and received a grant, so much remains to be done. This is particularly true in watersheds such as Missisquoi Bay and St. Albans Bay where phosphorus reductions are most critically needed. The Backroads Program's goal is to achieve 100% participation of Lake Champlain Basin towns by the end of the initial six year funding phase of Clean and Clear in 2009.

The annual number of projects correcting road erosion has been increasing, but the total number of roadside ditches, culverts, and banks that have been stabilized so far represents only a small fraction of what needs to be done statewide. By hiring a Backroads Technician in 2005, the Better Backroads Program has been able to tackle this challenge by visiting non-participating towns, encouraging their involvement, and offering on-site technical assistance in project development. In addition, the Technician is able to more thoroughly monitor implemented projects, evaluate their effectiveness, and offer follow-up suggestions. The Better Backroads Program has found that on-site assistance is a critical factor in gaining participation.








VT Town Participation in
Better Backroads Program
1997-2007
Town receiving one or more grants
Assoc. receiving one or more grants
Lake Champlain Basin Boundary
0 4 8 16 24 32
Miles

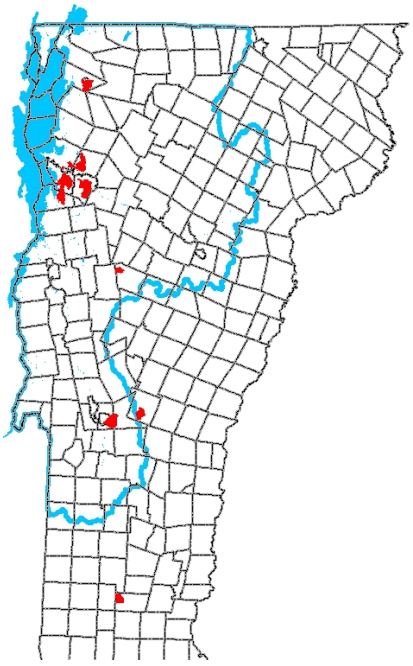
Stormwater Management

The Problem

Urbanization of the landscape creates surfaces that are impervious to water such as roads and driveways, parking lots, roof tops, and compacted soils. When rainwater and snowmelt run off impervious surfaces without infiltrating into the soil, sediment, phosphorus and other pollutants are washed directly into streams. Stream flows rise more rapidly during storms as the volume of runoff increases. These hydrologic changes destabilize and erode the stream banks and channels, resulting in further sediment and phosphorus pollution.

The Program

The Department of Environmental Conservation's Stormwater Management Program is a regulatory program charged with issuing permits for stormwater discharges statewide, and restoring acceptable water quality in stormwater impaired watersheds. A 25 year backlog of expired stormwater has been significantly reduced. State of the art standards for stormwater treatment systems are required for all newly permitted discharges. TMDLs and watershed remediation permit strategies are being developed for the 17 stormwater impaired watersheds in Vermont, including 14 within the Lake Champlain Basin. These 14 stormwater impaired watersheds represent about 1% of the total area of the Lake Champlain Basin in Vermont.



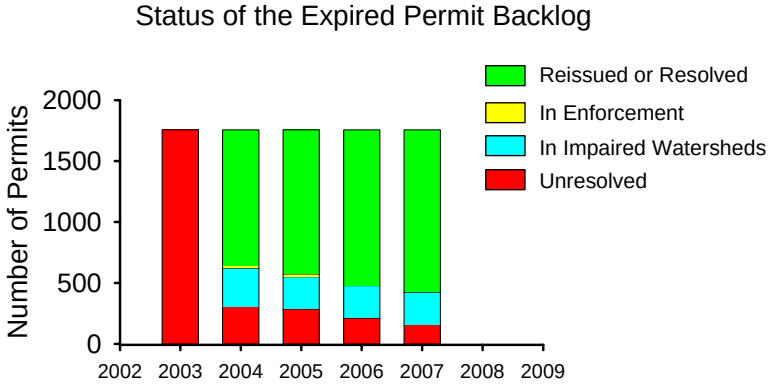
Stormwater Impaired Watersheds in Vermont

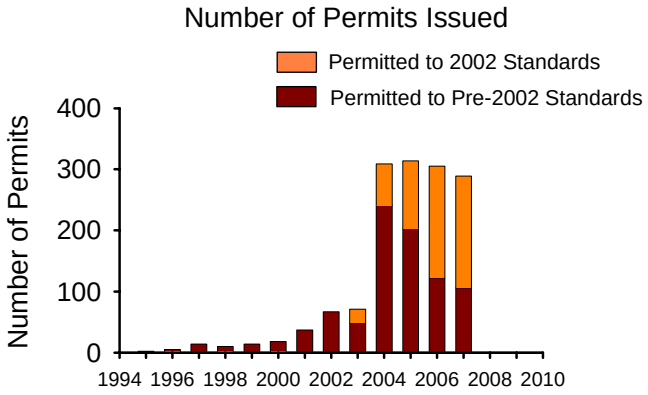
Program Accomplishments During 2007

Operational Permits

The program has made significant progress in reducing the backlog of expired permits. Of the original 1,757 expired permits, 1,330 (77%) have been either reissued, resolved, or referred for enforcement action.

The number of individual or general permits for new developments or redevelopment projects has increased to 265 in 2007. All new permits require stormwater treatment systems consistent with the standards in the 2002 Vermont Stormwater Management Manual. However, when permits are reissued for sites that were originally permitted prior to 2002 and that are not in impaired watersheds, the reissued permits use the pre-2002 treatment standards that were in place at the time of the original permit.





The total number of stormwater operational permits issued (new as well as previously expired permits) has increased dramatically in recent years as a result of organizational changes in the program that occurred in 2002 and the enhanced staffing levels provided by the Clean and Clear initiative beginning in 2004. This increase in the number of permits means that a much larger number of developed sites is coming under program oversight than in previous years, and suggests that the overall level of stormwater treatment in Vermont is improving. Additional staff facilitated a substantially increased field presence in 2007, as well as increased technical assistance to designers and property owners.

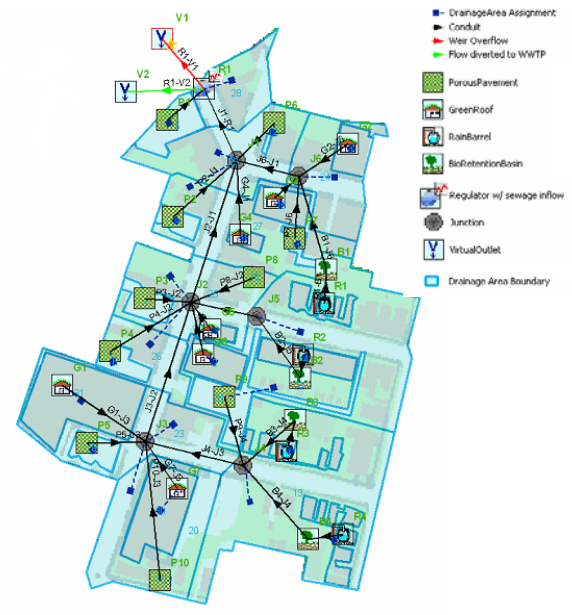
TMDL Development

The Potash Brook TMDL was approved by the U.S. Environmental Protection Agency (USEPA) in December 2006. In September 2007, USEPA approved TMDLs for Centennial, Englesby, Morehouse, and Bartlett Brooks. Draft TMDLs are currently being developed for Allen, Indian, Sunderland, and Munroe Brooks, with public drafts expected by December 2007. The remaining TMDLs are expected to be completed in 2008.

During 2007, the program has completed several projects to collect information for the development of stormwater TMDLs and to form the basis of a monitoring program for the stormwater impaired streams. This data collection has resulted in the formation of a process to develop stormwater TMDLs and their implementation plans and permits.

Stream Geomorphic Assessment

To help develop the implementation plans as well as support the monitoring phase of stream remediation efforts, the program has contracted with the University of Vermont and various consultants to develop a consistent baseline of stream geomorphic assessments (SGAs) for the stormwater impaired streams. The SGA data will be used to help focus the remediation efforts. Additionally, these data can be used as a point of comparison for future assessments to document improvements or degradation of these streams. Phase I and II SGAs have been completed for all 17 of the stormwater impaired streams.



Subwatershed mapping data used in the Vermont Best Management Practice Decision Support System.

Subwatershed Mapping

The objective of this project is to identify discharge points within the stormwater-impaired watersheds and delineate the associated watersheds for those discharge points. This involves consultants walking the streams and plotting the discharge points on a GIS map. The previously available subwatershed data are of varying quality. In some cases, there were data on stormwater collection systems and discharge points. However, all of the watersheds took a substantial amount of work to get accurate subwatershed delineation. The delineations of these sub-watersheds are helping to focus management efforts on higher risk areas within each stormwater-impaired watershed. The subwatershed data collection for all of the 17 watersheds was completed in 2006.

Flow Gauging and Precipitation Monitoring

Altered hydrology within the stormwater-impaired watersheds is the dominant factor in causing the impairments. In other words, increased levels of sediment laden runoff add to stream flow which accelerates erosion, further increasing the sediment load and exacerbating the impairment. To support the monitoring phase of stream remediation, the program hired a consultant to establish and operate stream flow and precipitation recording stations within each of the stormwater-impaired waters. These data will form an essential part of the adaptive management approach, as stream flow is anticipated to reflect the initial response to the implementation of the stormwater management plans. In addition to the streamflow data collected by the contractor in 2005, the department contracted with the University of Vermont to do three additional years of streamflow monitoring. The department received the 2006 flow monitoring data from the University in 2007.

Impervious Surface Mapping

The program is mapping the impervious surface area of each stormwater-impaired watershed. These data are being used in the development and implementation of the stormwater management plans. The impervious surface mapping is being done using QuickBird satellite imagery. This project will be completed in conjunction with the School of Natural Resources at the University of Vermont. The QuickBird satellite acquires high-quality satellite imagery for map creation, detection of change over time, and image analysis. The program has acquired QuickBird data for the stormwater-impaired watersheds and will perform the digital analysis of the data for these watersheds. The University of Vermont will apply advanced object oriented eCognition classification techniques to potentially improve the mapping accuracy for the previously analyzed data using the QuickBird satellite data. The program currently has impervious area data for 13 of the 17 impaired watersheds. The remaining watersheds are expected to be completed in 2008.

Imagery of a residential subdivision.

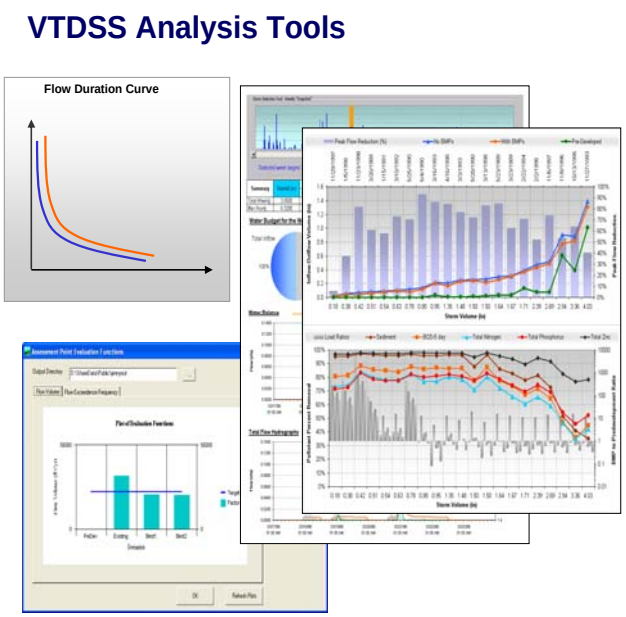
Impervious surfaces mapped on the residential subdivision.

Engineering Feasibility Assessment

A stormwater treatment pond.

To help develop the implementation plans, the program is currently collecting technical data for all significant stormwater treatment practices (including ponds, infiltration basins, constructed wetlands, etc.) in impaired watersheds. Technical information including pond volume, drainage area, and detention time is being collected through permit review and site modeling using HydroCAD software. Once information is collected, site visits are conducted to ensure the accuracy of data. In addition to data collection, the program is also conducting a limited engineering feasibility analysis at each site to determine what can reasonably be achieved at the site in regards to stormwater detention and infiltration. Data collection was completed in 2007.

Stormwater Impaired Watershed Remediation Permits



Stormwater best management practice computer modeling tools being developed for the Vermont Best Management Practice Decision Support System.

Upon EPA approval of the TMDLs, the department will develop permits to implement the targets. To do this, it is important to identify and size the appropriate best management practices (BMPs) to achieve the watershed targets. Because there are a plethora of BMP type, size, and location combinations, this type of analysis is typically extremely time-consuming. It may require numerous computer model iterations and a significant data pre- and post-processing effort. The urban nature of the impaired Vermont watersheds and their inherent spatial limitations make them particularly difficult and time-consuming to evaluate. Restoration may require implementing a large number of small-scale BMPs. To increase the efficiency in evaluating these watersheds, a BMP modeling tool that considers type, sizing, and placement and produces results that can be compared to TMDL targets is currently being developed. The department has contracted with TetraTech, Inc. to develop the Vermont Best Management Practice Decision Support System (BMPDSS). As of November 7, 2007, the BMPDSS engine has been completed by TetraTech and is undergoing final testing. Delivery of the BMPDSS interface with the Potash Brook model developed as a pilot is expected by the end of 2007.

Erosion Control at Construction Sites

The Problem

Construction activities that involve earth disturbance expose soil to rainfall and runoff, making it much more vulnerable to erosion. As a result, improperly managed stormwater runoff from construction sites can be a significant source of phosphorus-laden sediment reaching receiving waters. To minimize erosion and associated sediment transport by stormwater runoff from construction activities, construction site operators must implement and maintain a suitable suite of Best Management Practices (BMPs).

The Program

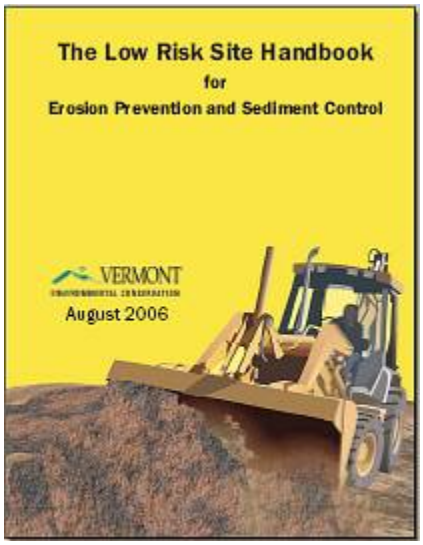
The Stormwater Section of the Water Quality Division issues federally mandated construction stormwater discharge permits for projects involving one or more acres of earth disturbance. The goal of the construction stormwater permitting program is to protect Vermont's waters by preventing the pollution of construction site stormwater runoff with sediment and phosphorus.

Accomplishing this aim requires equipping contractors with well developed Erosion Prevention and Sediment Control (EPSC) Plans, training them in the proper installation and maintenance of BMPs, and providing clear direction on their obligations as well as the motivation to fulfill them. In short, the program strives for meaningful water quality protection by thorough and efficient permitting, effective education and outreach, and fair and equitable compliance and enforcement.
Program Accomplishments During 2007

In September, 2006, the Construction General Permit (CGP) was reissued with a drop in the regulatory threshold from five acres to one acre of earth disturbance. In conjunction with this new permit, the program has made important strides in the three core areas: permitting, outreach and education, and compliance.

Permitting

The new CGP employs a novel, risk-based permitting system. Projects that qualify as Low Risk, based on the project location, site conditions, and volunteered limits on earth disturbance, are obliged to implement the practices in a BMP manual designed for use by the layperson. Because these projects do not pose a significant risk to water quality, they do not undergo a thorough review by technical staff. Permitting for Low Risk projects is expedited, allowing technical staff to devote more of their resources to the review of more complex projects that pose a higher risk of discharging sediment to waters of the state. These types of projects, which either qualify as Moderate Risk or require a customized Individual Permit, must submit a professional quality, site-specific EPSC Plan for review by technical staff.



Outreach and Education

Historically, site visits were focused in areas of the state with the largest number and size of projects, mostly in Chittenden County and ski area developments. In late 2006, the construction and post-construction stormwater technical staff were cross-trained and assigned responsibility for permitting and compliance in regional districts. This change, coupled with the move to a risk-based permitting system for construction stormwater permits allowed for a strong 2007 construction season field presence. This included a record number of site visits with a much broader geographic range. In their district roles, technical staff members have become familiar to the local regulated and consulting communities, thereby improving knowledge of the construction stormwater program and its requirements.

Compliance

The increased field presence in 2007 allowed for the most thorough assessment of program compliance to date. Compliance rates, though not yet at a satisfactory level, improved substantially. Historically, projects permitted under Individual Permits tended to be the only ones in general compliance with the terms of their permits. In 2007, the compliance rates for projects authorized under the new CGP have improved substantially, with significant non-compliance observed in less than 15 per cent of inspections. While many projects did have significant or minor non-compliance issues upon first inspection, once informed of the problems on their site, most permittees brought their project into compliance prior to a follow-up inspection. In many cases, these permittees and their contractors were first-time permittees.

Indicators of Progress

Permitting

With the change in regulatory threshold, the increase in authorized permits continued the annual trend of nearly doubling. The total acreage of planned disturbance permitted in 2007 also increased substantially. It may be presumed that an increase in number and size of regulated construction activity translates into more widespread implementation of proper EPSC BMPs.

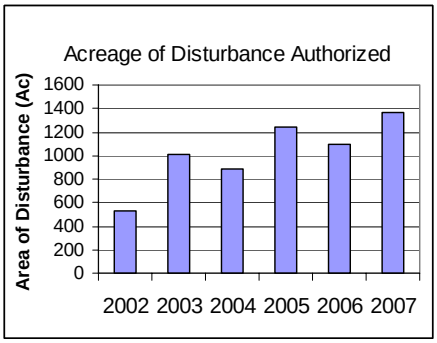
This two acre project, adjacent to Lake Champlain in Grand Isle Co., was referred to enforcement for failure to permit. In 2007, Stormwater staff expanded inspections in more rural areas across the state.

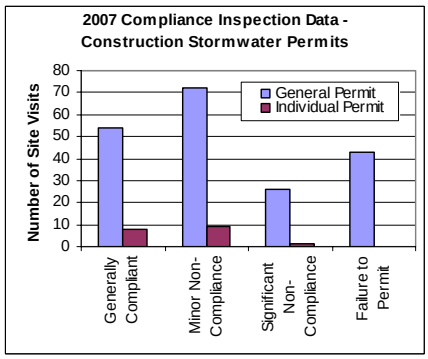
Compliance

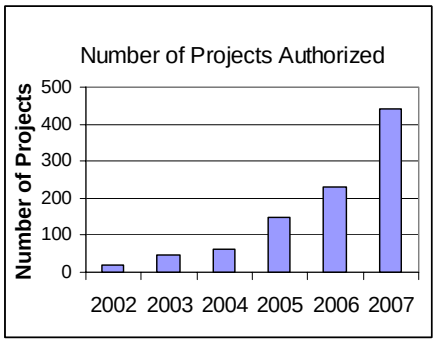
In 2006, compliance data collection was suspended during the overhaul of the program. In 2007, with the cross-trained and regionalized staff, over 200 site visits were conducted, far exceeding any previous year. This included inspections where the Stormwater Section has not previously had a presence, and anecdotal evidence suggests knowledge of the program in more rural areas of the state is spreading.

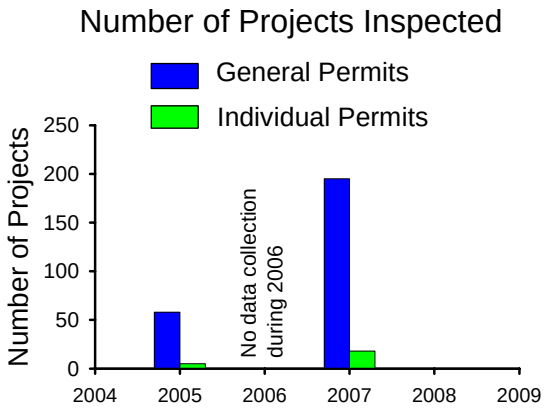
Nonetheless, compliance remains an area in need of additional focus. Over forty sites were identified in 2007 that did not obtain the required permit before beginning construction, and some permittees did not take sufficient steps to address identified non-compliance issues. Increased compliance assurance, including additional enforcement penalties and a further expansion of site inspections, are needed to help improve overall awareness of the permit program, and deter intentional noncompliance.

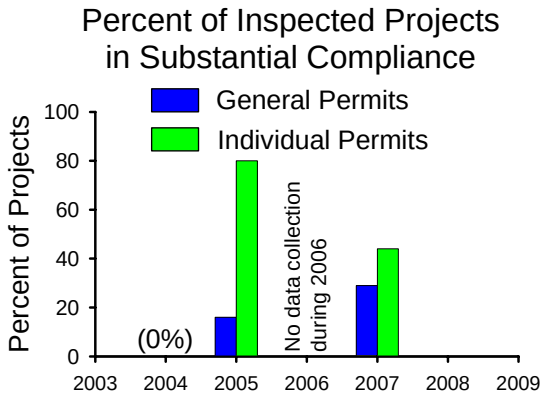
The combined effects of clearer regulations in permits, distribution of technical guidance materials, and the concerted effort to expand field presence has produced the most substantial improvement in compliance rates since the program's inception. In order to sustain the gains made in 2007 and fully realize the benefits of a regional staff model, vacant technical positions in the Stormwater Section will need to be filled. With reduced staff, permit backlogs develop and these reduce the time that staff can spend in the field, verifying and promoting compliance.











Local Municipal Actions

The Problem

State programs do not cover all activities that may cause phosphorus and other discharges to Vermont waterways. However, municipal plans, programs, and regulations can work to reduce phosphorus loading and other water quality and aquatic habitat impacts when tailored in ways that make sense to a particular community.

The Program

Regulations requiring measures such as vegetated riparian buffers, building setbacks from water, and appropriate erosion control provisions can be implemented at the local level to ensure that all projects meet minimum water quality protection standards.

Some of the specific measures that can be implemented at the town level to control phosphorus and generally protect water quality include the following:

- Streambank and lakeshore setback requirements
- Vegetated buffer protection
- Standards that minimize the creation of new impervious surfaces.
- Small construction site erosion control standards to minimize site disturbance and erosion
- Non-regulatory options such as the purchase of conservation easements, the re-planting of streambanks and shoreline, and educational events.

Through the Clean and Clear Action Plan, funds have been provided to the Vermont League of Cities and Towns to support a Water Quality Coordinator to engage and work with towns primarily in the Lake Champlain Basin. This position provides technical assistance to planning commissions, conservation commissions, selectboards, development review boards, and zoning boards to support water quality enhancements to their town plans, zoning regulations, or other municipal ordinances.

Program Accomplishments During 2007

In 2007, the Vermont League of Cities and Towns Water Quality Coordinator produced a Model Riparian Buffer Ordinance and a Technical Paper, which were mailed to over 1,000 municipal officials, including selectboard and city council members, planning commission chairs and zoning administrators across the state. In addition, a copy of the technical paper, titled “Creating an Effective Riparian Buffer Ordinance,” was included as an insert in the May 2007 VLCT News, which goes out to approximately 1,500 subscribers, including all of the towns in Vermont. The model ordinance and technical paper were written with collaboration and legal consultation from the VLCT Municipal Assistance Center.

The Model Riparian Ordinance prompted attention from towns interested in enhancing the water quality protections in their local ordinances. It provided a backdrop from which the Coordinator was able to draw to help towns draft customized water quality and streambank protection language. The Coordinator also produced a PowerPoint presentation entitled “Water Quality

Workshop – Where State Regulations Begin and End and Opportunities for Local Action," which covers stormwater, riparian buffers, floodplain protection and wetlands.

With the model ordinance and the water quality presentation, the Coordinator made direct contact with a number of planning and zoning officials, selectboard and city council members and conservation commissioners, including those from the following towns located in the Northern Lake Champlain watershed: Franklin, St. Albans, Swanton, Georgia, Bakersfield, Richford, Grand Isle, Enosburg Village, South Hero, and Hinesburg.

Within the rest of the Lake Champlain Basin, the Coordinator assisted municipal officials from the following towns: Essex, Burlington, Mendon, Greensboro, Rutland Town, Tinmouth, Rutland City, Brandon, Killington, Sudbury, Shrewsbury, Barre Town, Berlin, Cabot, Calais, Duxbury, East Montpelier, Fayston, Marshfield, Middlesex, Montpelier, Moretown, Northfield, Orange, Plainfield, Williamstown, Woodbury, Worcester, Roxbury, Waitsfield, Warren Washington, Waterbury and Worcester. The Coordinator also assisted the Planning Commissions in Vernon, Springfield and Concord, which are outside of the Lake Champlain Basin.

The Coordinator is working one-on-one with a subset of these towns that are currently involved in planning and zoning re-writes, and is available to assist others as their municipal boards engage in bylaw modifications.

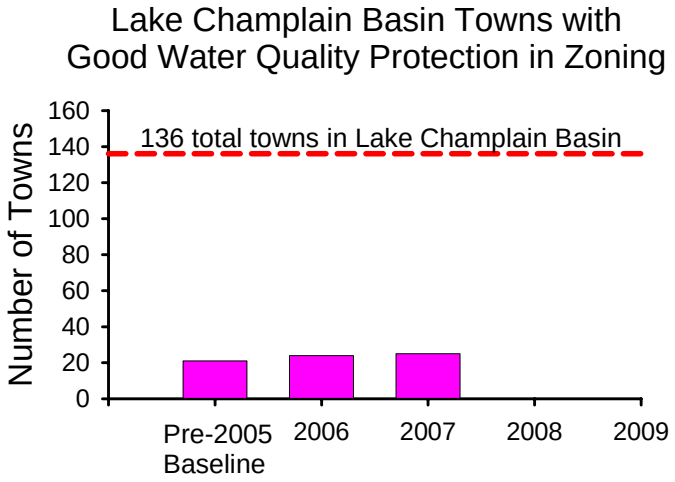
In 2007, the Water Quality Coordinator was appointed to the Mayor of Burlington's Stormwater Task Force, whose charge is to produce a comprehensive stormwater plan for the City that includes both construction and post construction stormwater management. The Coordinator was also appointed by the Montpelier City Council to the Montpelier River Restoration and Flood Mitigation Study Committee. The goals of the committee are to identify opportunities and develop long and short-term strategies to help mitigate flooding and to restore the health and balance of the Winooski River as it flows through Montpelier.

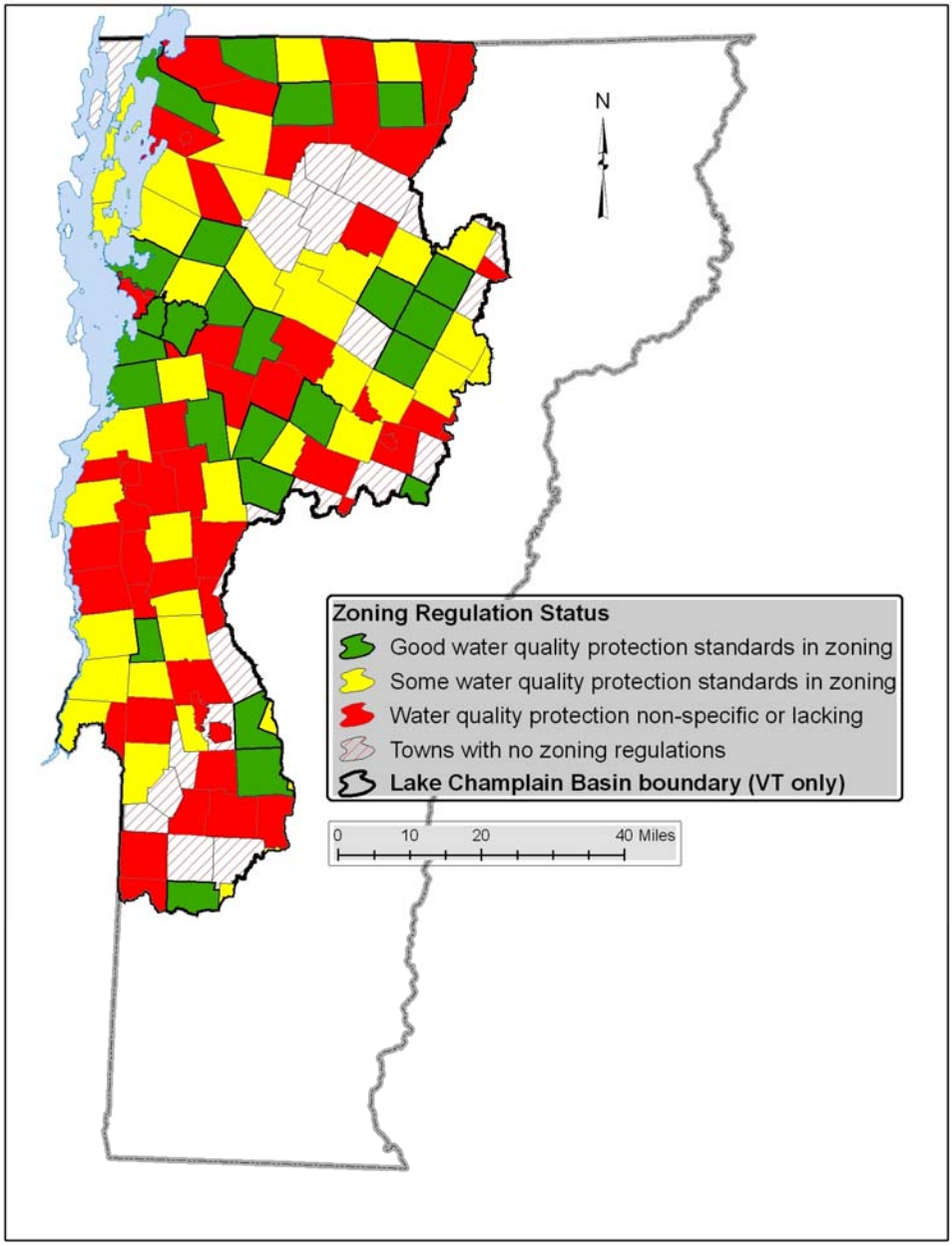
In conjunction with the Vermont DEC, a number of the most current town zoning or other applicable regulations for the 136 towns in the Lake Champlain Basin were re-evaluated for the existence of water quality protective language. The criteria used to evaluate zoning regulations include: streambank and lakeshore setback and buffer requirements, permitted and conditional uses in the buffer and setback, the existence of zoning districts relevant to water quality protection, flood hazard regulations with water quality protections above the standards necessary for NFIP coverage, steep slope development restrictions, impervious cover limitations, stormwater treatment criteria, erosion and sediment control standards, low impact development standards and highway/driveway curb cut standards. This review can be subjective to some extent, due to the considerable variation in how zoning regulations are written and organized. In addition, a town's status with regard to water quality protections is a dynamic process, as zoning regulations are amended periodically. The goal of the Local Municipal Actions program within Clean and Clear is to have all towns in the Lake Champlain Basin adopt good water quality protection standards in their regulations or other non-regulatory tools and practices.

Indicators of Progress

Activity	2006	2007	2008	2009
Number of town contacts made[1]	31	67		
Number of town board or commission meetings attended	21	35		
Articles written	4	3		
Information materials produced	38	33		
Number of meetings with partners	81	43		
Zoning regulations with new or enhanced water quality protection components[2]	25	7[4]		
Number of towns with good water quality protections in their zoning[3]	24	25		

[1] Any contact where information or technical assistance was provided on water quality topics.
[2] This indicates towns where there were some water quality protection language added and the town went from red to yellow, or from green or yellow to green, on the map, or perhaps didn't change color but there were enhancements in the zoning as indicated in the database.
[3] This is determined based on a review of the zoning regulations for setbacks from water, vegetated buffer strips, erosion control standards, stormwater standards, limited permitted or conditional uses in shoreland areas, protective conditional use or site plan review standards... The final determination takes into account all these factors and more but is of necessity subjective to degree.
[4] This number is additional enhanced zoning regulations for 2007 as compared to last year's number which was a cumulative value representing a number of preceding years.





Water quality protection zoning status of Vermont towns in the Lake Champlain Basin, 2007.

Wetland Protection and Restoration

The Problem

Many wetland areas in Vermont have been altered or destroyed to support land development or agriculture. This is a concern because wetlands serve an array of critical environmental functions; the protection of water quality foremost among them. Surface runoff often flows through wetlands prior to discharging into streams, rivers, or lakes. This runoff can contain a variety of contaminants, including excess nutrients such as phosphorus, which is the main focus of the Clean and Clear Action Plan. Riparian wetlands can then reduce phosphorus loading through sediment deposition, the binding of phosphorus to soil particles, and plant uptake. Protecting existing wetlands and restoring the functions of altered wetlands will expand the natural barriers to phosphorus loading in Lake Champlain and other state waterways.

The Program

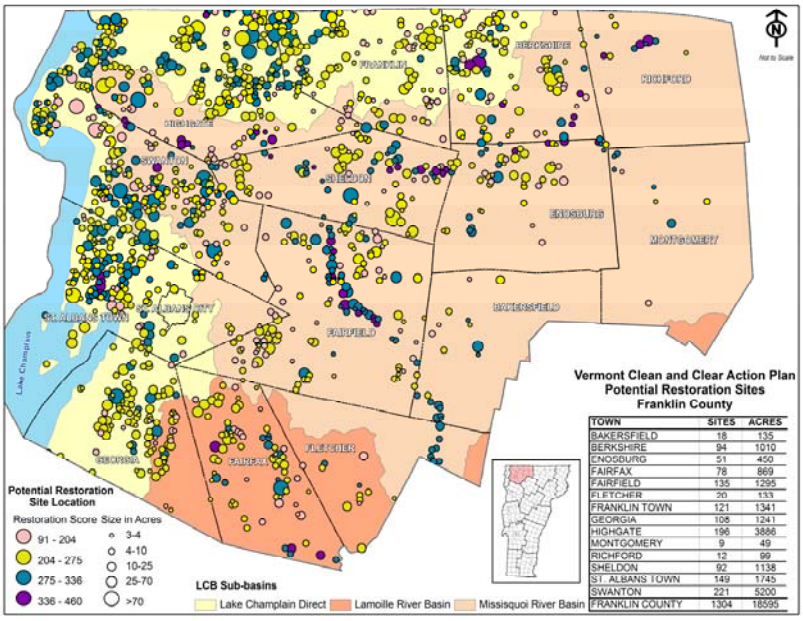
The State of Vermont has jurisdiction over wetlands through a variety of regulatory programs including the Vermont Wetland Rules, Act 250, and 401 Water Quality Certification. There are also some federal restrictions on wetlands that are managed by the U.S. Army Corps of Engineers. These regulatory programs help maintain the water quality benefits and other functions of existing wetlands. However, to date the state has already lost more than a third of its pre-colonial wetland acreage. To supplement these regulatory programs, and to reverse the trend of losing valuable wetland acreage, capital funds under the Clean and Clear Action Plan have been provided to protect and restore critical riparian wetlands.

Program Accomplishments

Lake Champlain Basin Wetland Restoration Plan

One of the most important functions of wetlands is the ability to attenuate nonpoint source phosphorus and thereby maintain and improve downstream water quality. Because of this capacity, restoration of degraded wetlands could be an important component of overall efforts to reduce nonpoint source phosphorus loading to Lake Champlain.

In 2006 the Agency commissioned a study to identify and prioritize wetland restoration opportunities in the basin. This plan provides information which will serve as the basis for a watershed-wide wetland



TOWN	SITES	ACRES
BAKERSFIELD	18	135
BERKSHIRE	94	1010
ENOSBURG	51	450
FAIRFAX	78	869
FAIRFIELD	135	1295
FLETCHER	20	133
FRANKLIN TOWN	121	1341
GEORGIA	108	1241
HIGHGATE	196	3886
MONTGOMERY	9	49
RICHFORD	12	99
SHELDON	92	1138
ST. ALBANS TOWN	149	1745
SWANTON	221	5200
FRANKLIN COUNTY	1304	18595

Potential wetland restoration sites in Franklin County identified by the Lake Champlain Basin Wetland Restoration Plan

restoration implementation plan for guiding future wetland restoration and protection activities. A draft of this study was completed in the spring of 2007 and public information meetings were held on the plan in the fall of 2007. The plan should be finalized by the end of 2007. The following text is a summary of the project results and recommendations:

Project Summary:

- Potential restoration sites on the 2.9 million acres of the Vermont portion of the Lake Champlain Basin (LCB) were identified using a geographic information system (GIS) model. The GIS model identified nearly 5,000 potential sites occupying more than 86,000 acres (135 square miles), and ranging from 3 (smallest size considered) to 1,490 acres.
- Once the potential sites were identified, the project team developed and field-tested a site prioritization model that included both site function and upslope drainage area criteria.
- The Lake Champlain Direct sub-basin had a large number of sites, and the Otter Creek sub-basin had the highest mean site function and upslope drainage area scores.
- High ranking sites were identified in all sub-basins.
- More than 80 highly-ranked sites were visited and evaluated by the project team.
- The floodplain forest, shrub swamp and shallow emergent marsh wetland were the primary natural community types recommended for restoration and provided the basis for the template restoration concepts included in the plan.

Project Recommendations:

- The project team recommended focusing initial restoration efforts on the Missisquoi River and Otter Creek sub-basins since they have the highest targeted P reduction goals. Restoration projects can be expanded out from those sub-basins as funds and resources are available.
- The Agency must include conduct public education and outreach in order to get landowners interested in wetland restoration efforts.
- A multimedia marketing and public relations campaign was recommended to advertise the project.
- The project team emphasized the need to determine appropriate compensation packages in order to get landowners interested in voluntary wetland restoration efforts.

Wetland Restoration Projects

Capital funds appropriated under the Clean and Clear Action Plan are being combined with funding from other partner organizations to support wetland restoration projects in the Lake Champlain Basin. This year three new wetland restoration projects have been identified with willing landowners. These projects involve wetland restoration on a total of 201 acres at sites in Weybridge, Whiting, and Bakersfield. The Agency has several other important restoration projects in the works throughout the basin and is in the early stages of negotiations with these landowners and project partners.

Cahill Farm wetland restoration site.

New Projects

The Cahill Farm Wetland Restoration Site: The State is partnering with the Natural Resource Conservation Service (NRCS) to restore 23 acres of wetland adjacent to the Black Creek in Bakersfield. This parcel will be permanently protected through a conservation easement, to be held by the NRCS. Under this partnership, NRCS will be paying for the easement and related expenses, and the state will be paying for restoration-related expenses. The state will be contributing $25,000 in Clean and Clear funds towards this effort.

The Saenger Farm Wetland Restoration Site: The State is partnering with the Natural Resource Conservation Service (NRCS) to restore 152 acres of riparian area and wetlands adjacent to the Otter Creek in Whiting. This parcel will be permanently protected through a conservation easement, to be held by the NRCS. Under this partnership, NRCS will be paying for the easement and related expenses, and the state will be paying for restoration-related expenses. The state will be contributing $61,000 in Clean and Clear funds towards this effort.

The Gibb Farm: The Gibb Farm is a 285-acre property in Weybridge, Vermont. The property is owned by the Gibb Family Trust. The family is interested in selling a 36-acre portion of this parcel to the state so that it could be added to the Lemon Fair fish and wildlife management area. The Wetlands Protection and Restoration Program is pursuing the acquisition of the approximately 36-acre portion of the farm with Clean and Clear funds. This portion of the farm has nearly 3,700 feet of frontage along the Lemon Fair River. The 36-acre parcel of interest includes both restoration (18 acres) and protection (18 acres) components. It has intact forested areas at its northern and southern ends, and an area in between that has been farmed to corn in the past. Apparently this area is not critical to the current farmer as planted crops have failed half the time due to flooding. The farmed area will be restored to wetland in a passive manner. Passive restoration would involve simply letting the area re-vegetate naturally into a floodplain forest over time. Restoring the wetland will help protect the water quality of the Lemon Fair River and ultimately Lake Champlain, into which it eventually flows.

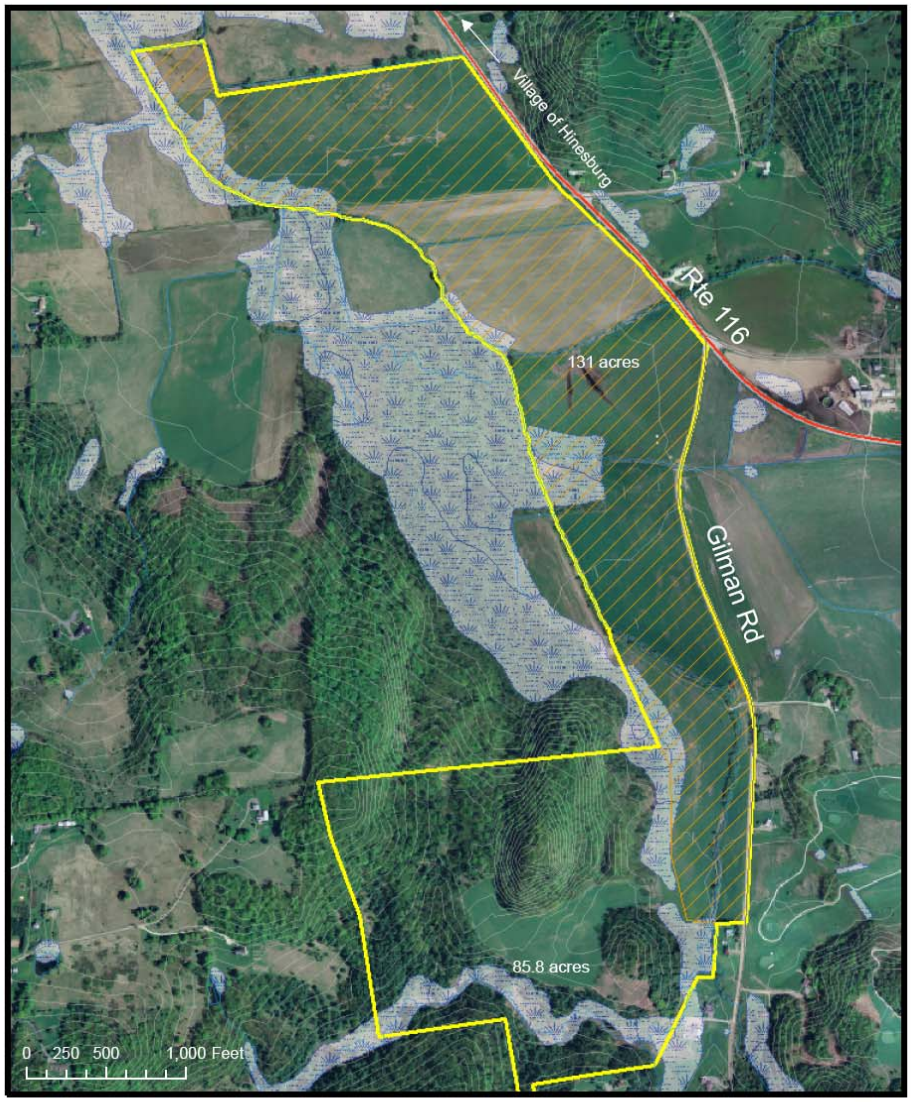
Gibb Farm wetland restoration site.

Update on Previously Reported Projects

The Miner/Dutil Farm Wetland Restoration Sites: Last year we reported on the planned restoration of these two sites for a total of 177 acres in partnership with the NRCS. Unfortunately after the appraisals were completed for these parcels and offers were made to the landowners, the landowners decided not to move forward with the project. Lands that are suitable for wetland restoration generally appraise at a low value since they are often located in floodplains and are not suitable for development. This is a challenge for the program.

The Bissonette Farm: The Hinesburg Land Trust closed on this project in October 2007. The Agency committed $120,000 towards the purchase of 131 acres of drained wetlands along the

LaPlatte River. These wetlands will be restored. The Natural Resource Conservation Service will design and fund the wetland restoration plan. The plan should be implemented in 2008.

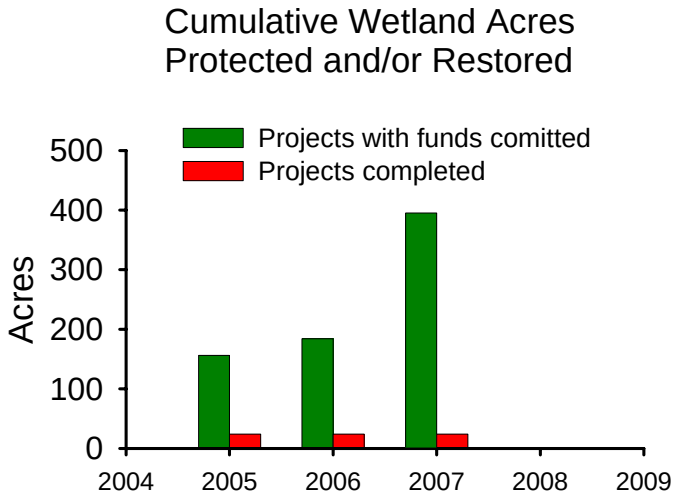


LaPlatte Headwaters on Bissonette Farm - Parcel 1
Hinesburg VT

Parcel 1 - 216.84 acres total
Wetland Restoration Area - 131 acres
Wetlands
10 foot contours

Indicators of Progress

The process of bringing a wetland restoration project to completion can take several years since such projects usually involve complex negotiations and agreements among landowners, state, local, and federal government agencies, and non-profit organizations. The success of wetland protection and restoration efforts under the Clean and Clear Action Plan is therefore tracked by documenting the acreage of wetlands protected and restored, as well as the acreage committed to be protected and restored.



Forest Management

The Problem

Sediment is the most common pollutant associated with timber harvesting. Soil can be carried by rainwater after timber harvesting equipment and trees dragged or carried over the ground loosen and expose the soil. Bare ground exposed during harvesting operations can be eroded by rainwater and enter nearby streams causing sedimentation. The presence of an intact forest floor on the soil surface protects soil from being eroded. The forest floor is composed of the litter layer, underlying organic layer (humus), and fibrous roots.

In recent years, Vermont timber harvests have yielded about 900,000 cords annually. Although the Lake Champlain Phosphorus TMDL indicated that forest land delivered only about 6% the total nonpoint source phosphorus load to Lake Champlain from Vermont, work continues to accelerate the implementation of practices to protect water quality during timber harvesting operations. Stream crossings used during harvesting have been a particular area of concern in eliminating discharges of sediment. With forests covering more than 4.6 million acres and representing 78% of Vermont's total land base, forestry continues to be an area worthy of efforts to reduce sedimentation and phosphorus loading to state waters.

The Program

The Watershed Forestry Program of the Vermont Department of Forest, Parks, and Recreation (FP&R) is focused on efforts to protect and conserve Vermont's forests for the explicit contribution that this land use provides for water quality. Education, outreach and technical assistance is provided to forest landowners, loggers, forestry professionals and the general public in regards to forestry principles and practices associated with protecting forest water quality, preventing soil erosion and maintaining forest riparian health. The program also administers the "Acceptable Management Practices (AMPs) for Maintaining Water Quality on Log Jobs," Vermont's "Heavy Cutting Law" (ACT 15) and provides Act 250 review of logging operations to ensure that appropriate measures are taken to protect water quality and prevent erosion when logging above 2,500 feet elevation.

Program Accomplishments During 2007

AMP Program

The AMPs were developed and adopted as rules to Vermont's Water Quality Statutes, and became effective on August 15, 1987. The AMPs are designed to prevent sediment, petroleum products and logging slash from entering waters of the state. The AMPs are based on principles that have been scientifically proven and tested over time. When implemented correctly, they have proven to be effective in maintaining water quality and preventing erosion on forest harvesting operations.

Since adoption of the AMPs, FP&R has worked with representatives from the Vermont Forest Industry to support the Agency of Natural Resources (ANR) Enforcement Division in an effort to reduce the number and severity of water quality violations resulting from timber harvesting

operations. In 2007, FP&R staff provided technical assistance on 41 cases. There continues to be a high level of cooperation and voluntary compliance among loggers and landowners to bring operations into compliance with Vermont's Water Quality Statutes.

Portable Skidder Bridge Initiative

Portable skidder bridges are designed and intended for use as temporary structures for crossing streams during logging. When properly installed, used and removed, they create less stream bank and stream bed disturbance as compared to other acceptable AMP alternatives such as culverts or poled fords. They are also economical since they are reusable, and easy to install and transport from job to job. Portable skidder bridges will reduce the potential for sedimentation, channeling and degradation of aquatic habitat to occur while allowing loggers to harvest timber in compliance with the AMPs.

Portable Skidder Bridge Workshop. Richmond, VT – 2006.

This initiative entails a three-phase action plan:

- Phase 1 – Inform loggers, landowners and foresters about the benefits of using portable skidder bridges through workshops and presentations, field demonstrations, informational brochures, static displays, video and web production, and news articles. This phase has been on-going since 2005 and will continue.
- Phase II – Provide portable skidder bridges to loggers for purchase, loan and rental using a variety of means and partners.
- Phase III – Provide assistance and support for existing and start-up businesses that would fabricate and sell portable skidder bridges.

This year, the Portable Skidder Bridge Rental Program was started with two pilot projects getting underway in Lamoille and Rutland counties. This program is a joint venture between the Department of Environmental Conservation (DEC) Basin Planning Program, the FP&R Forest Watershed Program and Natural Resource Conservation Districts (NRCD). Vocational high school forestry students from the Green Mountain Technology and Career Center in Hardwick and the Stafford Technical Center in Rutland were actively involved with sawing materials for the bridges and provided manpower in assembling them. "Hands-on" bridge building workshops were held at both Technical Centers during the spring of 2007 and were attended by the forestry students as well as area loggers.

Loggers and landowners can rent the bridges from the Lamoille County and Rutland County NRCD. The bridges are conveniently located for loggers to pick up and return at Manosh Hardwoods in Morrisville, Buffalo Mountain Wood Storage in Hardwick and Gagnon Lumber in Pittsford.

The Environmental Protection Agency provides grants to states to address Non-Point Source (NPS) pollution through the Section 319 Grants Program. During 2007, the FP&R Watershed Forestry Program, working with the Northern Rural Conservation and Development (RC&D) Program secured a grant through this grants program to start phase III of the Portable Skidder

Bridge Initiative. The project will focus on the northern watersheds of the Lake Champlain Basin within the jurisdictional boundaries of the Northern Vermont RC&D.

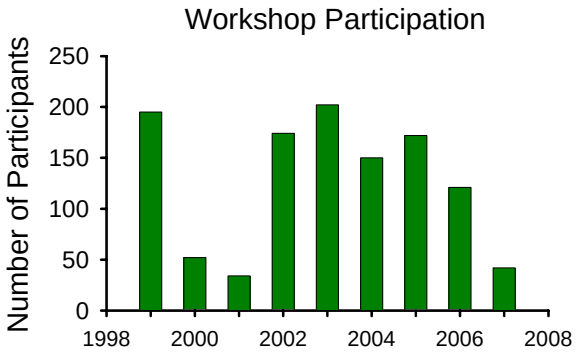
Interested sawmill owners located within the project area will be solicited to build portable wooden skidder bridges and make them available to loggers working in the northern Lake Champlain Basin. A minimum of sixteen bridges will be built and available for loggers to use free of charge. Participating loggers will be provided an educational packet and receive training on the proper installation, use and removal of the bridges while following Vermont's AMP's to protect water quality and prevent soil erosion. A project forester will be hired to coordinate on the ground activities which will include tracking, AMP compliance monitoring and education and outreach.

Jericho Research Forest Project

During 2007 the Watershed Forestry Program in collaboration with the DEC River Management Program and the University of Vermont Rubenstein School of Environment and Natural Resources designed a project to gain a better understanding of the geomorphic impacts associated with past and present timber management practices in forested headwater streams. The "Roger's Tract" of UVM's Jericho Research Forest was chosen as the project site. The goal of the project is to develop a collaborative assessment, restoration, monitoring, and forest management demonstration project at the Jericho Research Forest.

A qualified contractor was hired through a competitive bidding process to assess the condition of headwater streams on the Rogers Tract following the Vermont Agency of Natural Resources Stream Geomorphic Assessment Protocols. Other potential impacts associated with past or present logging activities including the alteration of streams and drainage patterns, the use of conveyances, including hillside culverts, drainage ditches, and gullies caused by logging activities, road and skid trail construction and stream crossings as well as soil compaction were also assessed. Outreach events for this project will be conducted in the fall of 2007 and winter of 2008 with the final Assessment Report due in April 2008.

Education and Outreach



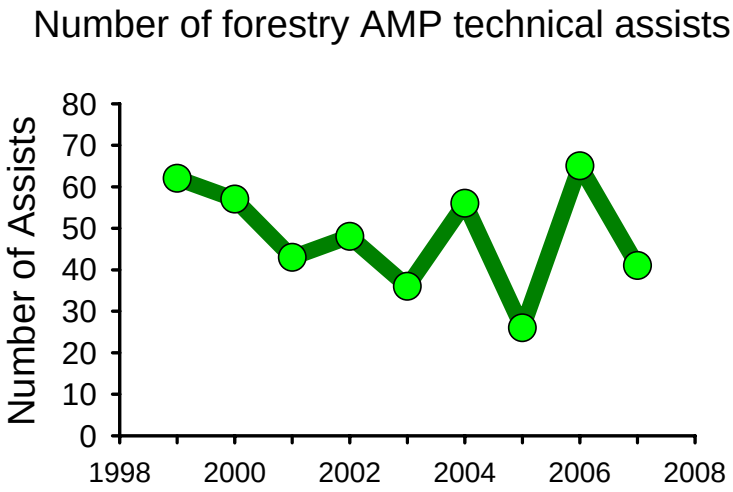
The Vermont Department of Forests, Parks and Recreation provides support to Vermont logger education programs in education and training by participating in workshops for loggers. The Watershed Forestry Program has extended this effort to include opportunities for landowners and private consulting foresters on the topic of forest water quality and forest riparian health. During 2007 the Watershed Forestry Program organized a Forest Water Quality workshop for loggers enrolled in the Logger Education to Advance Professionalism (LEAP) program. The Watershed Forestry Program was also invited to provide a full morning of presentations to loggers, landowners and private consulting foresters on the topic of forest water quality and erosion control. The workshop was hosted by the Bennington County Sustainable Forestry Consortium. Also during 2007, the Watershed Forestry Program was invited to speak and lead a field session for a class of forestry students at the University of

Vermont School of Environment and Natural Resources on the topic of forest water quality and AMP's.

The video "Better Stream Crossings Using Portable Skidder Bridges" was released in 2007. The production of this video was made possible through the Watershed and Clean Water Grants Program administered by the USDA Forest Service, State & Private Forestry. The video covers all elements of building and using portable skidder bridges and includes live testimony from loggers about the economic and environmental benefits to their logging operations. The video was widely distributed within Vermont to twenty northeastern state forestry agencies and logger education organizations from Maine to Minnesota and Missouri. It is being used as an education tool for loggers and forest landowners in Vermont. Other states including Maine, Wisconsin and the Watershed Agricultural Council's Forestry Program that protects New York City's water supply have incorporated the video in their logger training programs.

Indicators of Progress

There is no apparent upward or downward trend in the number of AMP technical assists as indicated by statistics for the last several years. However, FP&R staff has observed that the water quality violations are becoming less severe. AMP records from 1999 to present indicate that the number of technical assists on timber harvesting operations ranged from a low of 26 during 2005 to a high of 62 during 1999. The numbers vary due to many variables such as amount and distribution of annual rainfall, number and timing of timber harvesting operations, etc.

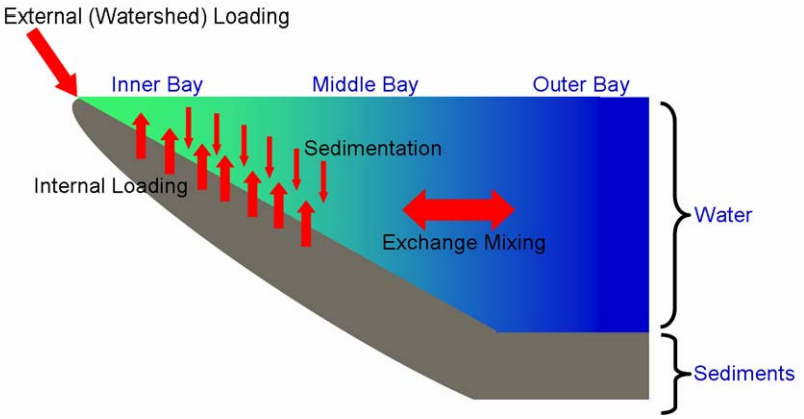


The Portable Skidder Bridge Initiative is long-term and will continue to be an integral part of the Watershed Forestry Program. The use of portable skidder bridges as a method for crossing streams during logging operations is gaining popularity as loggers, landowners and foresters realize their environmental and economic advantages. FP&R will continue its efforts to increase awareness of the multiple benefits of using these designs as a Best Management Practice for temporary stream crossings to be used during timber harvesting operations. The number of loggers using portable timber bridge designs now and in the future will provide a useful indicator for both the Watershed Forestry Program and the Clean and Clear Initiative.

St. Albans Bay Studies

The Problem

Phosphorus has accumulated in the sediments of St. Albans Bay from decades of excessive loading from point and nonpoint sources in the watershed. This sediment store of phosphorus is now recycling back into the water and is continuing to feed algae blooms in the bay in a process called "internal loading." Water quality standards in St. Albans Bay may not be achieved until this internal phosphorus loading from the bay's sediments declines.



The phosphorus cycle in St. Albans Bay, showing internal phosphorus loading from the bay's sediments.

The Program

The Lake Champlain Phosphorus TMDL proposed consideration of treating the sediments with alum (aluminum sulfate) to control the internal loading. The TMDL plan indicated that such a treatment should be conducted only if it is shown to be technically feasible and environmentally acceptable, and only after progress is made in reducing the existing nonpoint source phosphorus loading from the bay's watershed.

A St. Albans Bay sediment core study funded by Clean and Clear and conducted by the University of Vermont Department of Geology during 2004 found that a substantial reservoir of phosphorus remains in the sediments of St. Albans Bay and that this stored phosphorus has the potential to recycle back into the water of the bay for a long period of time into the future. Given these findings, the Agency of Natural Resources initiated a feasibility study for the control of internal phosphorus loading in St. Albans Bay, using Clean and Clear funds appropriated in FY 2007.

The feasibility study was designed to be conducted in two phases. The purpose of the first phase was to compare treatment options for the control of internal phosphorus loading in St. Albans Bay as to their feasibility, likelihood of success, environmental impacts, and cost. A second phase of the study will provide a detailed treatment design for the chosen alternative and supply most of the information needed to support the environmental permitting process for the treatment method. The Agency of Natural Resources was assisted on the study by a Project Advisory Committee composed of Lake Champlain Basin scientists, resource managers, and area citizens.

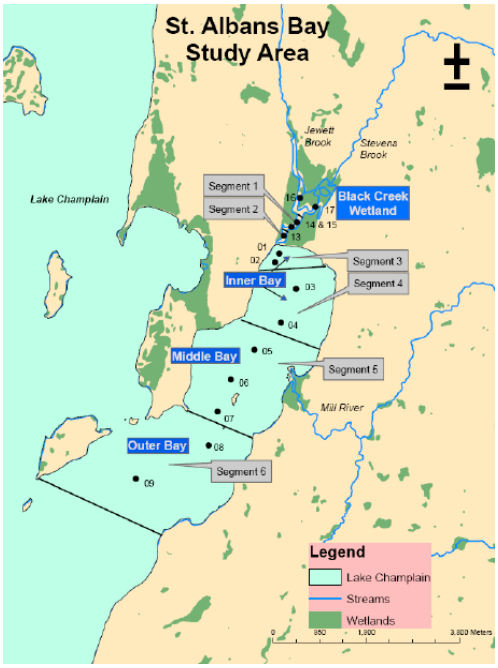
Program Accomplishments During 2007

A contract for the feasibility study was awarded to ENSR Corp. in 2006 following a competitive proposal evaluation process, based on the recommendation of the Project Advisory Committee. Draft findings were presented and discussed at a public meeting in St. Albans in May 2007, and

ENSR provided a final Phase 1 report in June 2007 following technical review by the Project Advisory Committee. The Phase 1 report titled "*Feasibility Study for the Control of Internal Phosphorus Loading in St. Albans Bay, Lake Champlain"* can be found at: http://www.anr.state.vt.us/cleanandclear/StAlbansBay-FinalReport-Phase1.pdf

The Phase 1 report evaluated several alternative methods for controlling internal phosphorus loading in the bay as to technical feasibility, cost, and environmental impacts. After screening a wide variety of lake management techniques, ENSR focused on the following four lake management options for St. Albans Bay:

- Circulation
- Dredging
- In-Lake Phosphorus Inactivation
- Input Reduction by Tributary Dosing



St. Albans Bay study area.

Circulation was not found to be feasible for St. Albans Bay because the bay is already well mixed vertically by wind-driven currents and does not stratify thermally. Mixing for the purpose of disrupting algal scums is not likely to be helpful on a bay-wide scale due to the mixing regime already present.

Hydraulic dredging was considered to be an effective means for removing phosphorus-laden sediment from St. Albans Bay. However, the costs would likely be prohibitive. Cost estimates ranged from $2-54 million for dredging the wetland channel and inner bay only, and $9-277 million for dredging the entire bay. The actual cost within these large ranges would depend on the depth of sediment removed and other factors that would need to be determined during a Phase 2 analysis. In addition to dredging costs, factors such as the large land area needed for local disposal of dredged materials (potentially hundreds of acres piled several feet high), and environmental impacts on benthic organisms such as native mussels, were thought to make dredging an infeasible alternative for St. Albans Bay.

Phosphorus inactivation of bay sediments by treatment with aluminum compounds (alum and sodium aluminate) was found to be technically feasible. Cost estimates ranged from $0.6-3.6 million for treating the wetland channel and inner bay only, and $4.4-28.7 million for treating the entire bay. The actual cost within these ranges would depend on the aluminum dose necessary to inactivate the phosphorus in the sediment, a factor that would need to be determined during a Phase 2 analysis.

ENSR noted that the effectiveness of alum treatments in lakes is short-lived when external phosphorus loading from the watershed is not controlled before the in-lake treatment. Since nonpoint source phosphorus loading rates to St. Albans Bay are high, ENSR recommended that phosphorus loading from the watershed should be substantially reduced prior to any in-lake

treatment. This is also consistent with the recommendation in the Lake Champlain Phosphorus TMDL.

Phosphorus input reduction by dosing tributary streams with aluminum compounds during runoff events was proposed by ENSR as an interim measure while watershed management is being implemented to control external phosphorus sources. The cost for a dosing station at the outlet of Stevens Brook (at Black Bridge) was estimated to be $257,000-350,000 for the first year, with reduced annual costs ($92,000-139,000/yr) in subsequent years. Treating the other major inflow from the Mill River would approximately double these costs.

In summary, ENSR recommended a program that includes tributary dosing of incoming water from Stevens and Jewett Brooks (at Black Bridge) with alum as an interim measure while watershed sources are being addressed. Treatment of sediments of the inner bay using aluminum compounds was also recommended once external loads are reduced either by watershed management or by establishment of tributary dosing stations. A Phase 2 analysis would be needed to better define the project and more fully evaluate the environmental impacts. The Agency of Natural Resources in currently considering the recommendations from the Phase 1 report in order to determine the direction and timing of the Phase 2 analysis or other next steps.

Monitoring and Research

The Problem

The ultimate goals of the Lake Champlain Phosphorus TMDL implementation plan are to take all the actions necessary to attain the loading limits specified in the TMDL for each sub-watershed, and to achieve the in-lake phosphorus water quality criteria for each lake segment. Long-term water quality and land use monitoring is needed to determine whether these targets are being achieved, and to understand the reasons when goals are not being met.

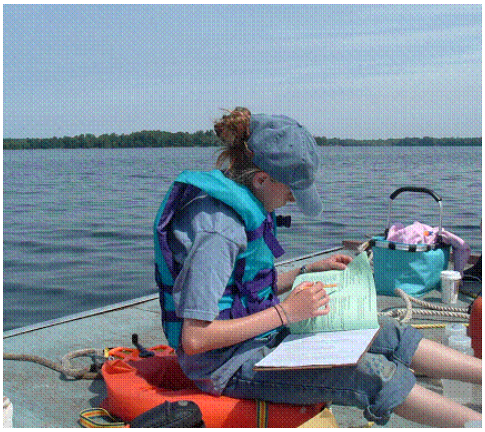
Phosphorus loading to Lake Champlain is strongly influenced by land use in the watershed. The phosphorus runoff rate (pounds per acre per year) from agricultural land is, on average, about ten times the rate from forested land. Developed land yields about three to four times more phosphorus per acre than agricultural land. The development of forested and agricultural land is occurring in some portions of the basin, creating the potential for increased phosphorus loading.

Nonpoint source management practices are being implemented in watersheds throughout the country in order to reduce phosphorus and other pollutants from urban and agricultural sources. However, the quantitative effectiveness of many of the practices that are suitable for Vermont is not known with scientific certainty. More research is needed on the magnitude of phosphorus reductions that can be expected from these practices so that progress toward the Lake Champlain TMDL loading targets can be better quantified.

Sampling Lake Champlain for the Long-Term Monitoring Program.

The Program

The states of Vermont and New York jointly conduct the Long-Term Water Quality and Biological Monitoring Program on Lake Champlain with support from the Lake Champlain Basin Program. The program measures phosphorus and many other parameters in the lake and its tributary rivers. All chemical analyses are conducted by the Vermont DEC Laboratory. The tributary monitoring results are analyzed with data from the network of stream flow gauges in the basin operated by the U.S. Geological Survey. In addition, citizen volunteers have sampled the lake every summer since 1979 as part of the Vermont Lay Monitoring Program.



A volunteer lay monitor records data on Lake Champlain.

Clean and Clear funds supported a project at the University of Vermont to update the land use data for the

entire Lake Champlain Basin, and to identify areas of the basin where changing land use has affected phosphorus export rates. Technical oversight for this project was provided by the Lake Champlain Basin Program.

Clean and Clear FY 2007 funds were approved for a research project at the University of Vermont to begin developing a phosphorus accounting system for the Lake Champlain Basin. The purpose of the project is to review major sources of phosphorus across the landscape and the processes that transport phosphorus to the lake, outline the most scientifically credible approach to developing a phosphorus accounting system that tracks both gains and losses, and present a detailed workplan for collecting the necessary data and moving forward with the development of such an accounting system. This project began in May 2007 and is being developed in consultation with the Lake Champlain Basin Program Technical Advisory Committee.

The Vermont ANR River Management Program and the University of Vermont Water Resources and Lake Studies Center have pooled resources in recent years in order to jointly support a river management research program. Clean and Clear funds are used to match federal funds to support grants awarded by the Water Resources and Lake Studies Center through a competitive process. The general objectives of the program are:

1. To advance scientific understanding that helps quantify the contribution of sediment and nutrients derived from fluvial processes in Vermont's rivers.
2. To establish the socio-economic justifications, costs, and benefits associated with or represented by river corridor protection in Vermont.
3. To contribute to Vermont's river corridor management, restoration, and protection infrastructure.

Projects funded through this joint ANR and University of Vermont program that are currently in progress include the following.

- Evaluating Quantitative Models of Riverbank Stability. University of Vermont School of Engineering and Department of Geology.
- An Adaptive management System using Heirarchical Artificial Neural Networks and Remote Sensing for Fluvial Hazard Mitigation. University of Vermont School of Engineering and Rubenstein School of Environment and Natural Resources.
- Phosphorus availability from the soils along two streams of the Lake Champlain Basin: mapping, characterization and seasonal mobility. University of Vermont Department of Plant and Soil Science.

Program Accomplishments During 2007

Lake Champlain Long-Term Water Quality and Biological Monitoring Program

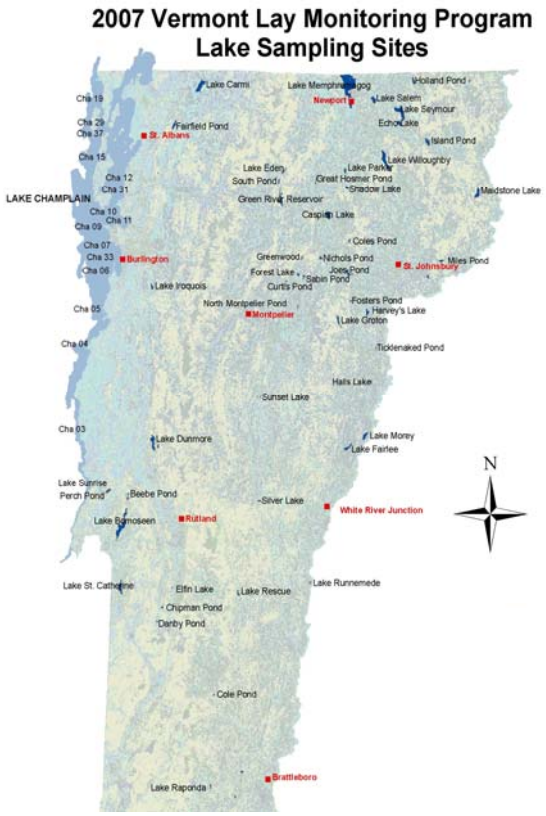
Water quality monitoring continued during 2006 on Lake Champlain and its tributaries. This information is updated annually on the Lake Champlain Long-Term Monitoring Program website, where the data and graphical summaries are freely available to researchers, students, consultants, and the general public. http://www.anr.state.vt.us/dec/waterq/lakes/htm/lp_longterm.htm

Vermont ANR monitoring program staff at are working closely with technical staff and partners at the Lake Champlain Basin Program to analyze the long-term monitoring program in order to

produce a new State of the Lake Report and Ecosystems Indicators Scorecard. This report is planned for release in June 2008.

Vermont Lay Monitoring Program

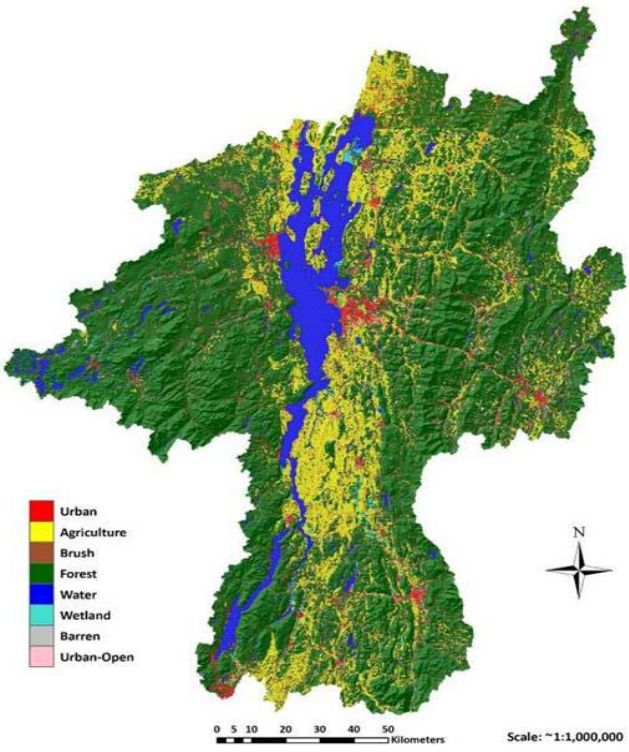
The Vermont Lay Monitoring Program completed its 29th consecutive sampling season in 2007. More than 75 volunteers helped sample 16 stations on Lake Champlain and 53 inland lakes weekly during June, July and August. Program staff visited the Lay Monitors, took duplicate samples in the field as part of the quality assurance plan, transported and logged in all samples to the DEC Laboratory for analysis, and upgraded sampling equipment as needed. As in past years, weekly Secchi water clarity readings were provided to Channel 3 Television News, WCAX, for their reporting and Lake Champlain Lay Monitors continued to provide bi-weekly algae samples for a study of blue-green algal toxins being conducted by the University of Vermont.



Lake Champlain Basin Land Use and Phosphorus Loading Study

A final report on the Lake Champlain Basin Land Use and Phosphorus Loading Study was completed by the University of Vermont in May 2007 following extensive scientific review by the Technical Advisory Committee of the Lake Champlain Basin Program. The purposes of the study were to produce an updated land use and land cover data layer for the entire basin, analyze changes in land use between 1992 and 2001, and develop updated phosphorus loading estimates for each subwatershed based on the new land use data.

Comparative analysis of the new 2001 and corrected 1992 land use data indicated that change was most pronounced in three land use classes: urban (+1.9%), agriculture (-5.4%), and brush (+4.5%). With respect to phosphorus loading, the report found that, on average basinwide, 53% of the nonpoint source phosphorus load to Lake Champlain came from urban or developed land, 39% from agricultural



Lake Champlain Basin land use ca. 2001.

land, and 8% from forest land. This breakdown varied by watershed, however. For example, it was estimated that nonpoint source loads in the Missisquoi Bay watershed (Vermont and Quebec) were derived from agricultural land (68%), urban land (28%), and forest land (5%). The text of the study can be found on the Lake Champlain Basin Program web site: http://lcbp.org/publication_detail.aspx?id=211

Vermont ANR and University of Vermont Joint River Management Research Program

The University of Vermont Water Resources and Lake Studies Center issued a request-for-proposals in November 2007 for river management research projects to be conducted during 2008-2009. Suggested research priorities included the following:

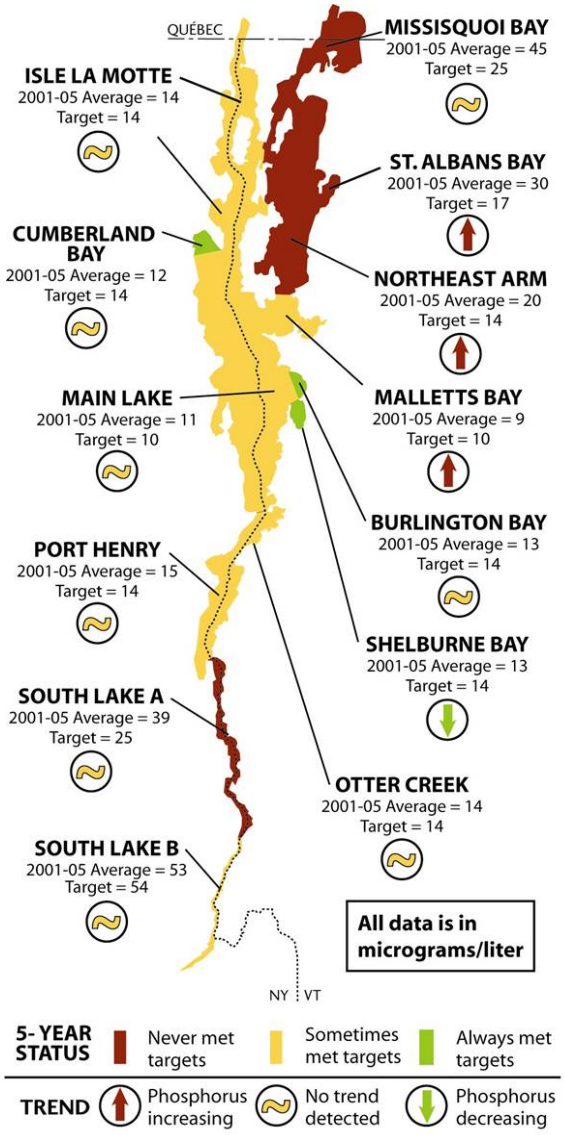
- Build on the existing ANR stream geomorphic assessment protocol, develop techniques for systematically identifying critical in-stream source areas, meaning those segments of the river system that contribute a disproportionate amount of the total P/sediment load.
- Quantify how sediment and nutrient reductions may be achieved by managing river systems toward equilibrium conditions, and alleviating constraints to sediment load attenuation at a watershed scale.
- Examine and quantify the P and sediments available to be mobilized by fluvial processes and represented in various legacy sediment accretions in the Northern Lake Champlain watershed.
  Quantify sediment and P production in selected meso/macro scale examples and relate to the extant of fluvial geomorphic evolution or adjustment processes and the driving forces and stressors for such adjustments.
- Collect new and/or use existing data to test fluvial-geomorphic-based models currently being applied by the River Management Program and generate innovative new map products.
- Place fluvial adjustment processes and sediment/P production rates on a geologic time scale/continuum such that a comparison of rates of sediment/P delivery to receiving waters can be made.
- Identify/test/validate innovative voluntary landowner and municipal incentives that could be created in Vermont to enhance participation in river corridor protection initiatives.
- Quantify the socio-economic costs and benefits of river corridor protection.
- Identify economic factors that have driven river and river corridor management historically (nineteenth and twentieth centuries) as compared with current day economic drivers and develop ways to use this information in way to that might influence public perception/values.

Indicators of Progress

The Lake Champlain Basin Program presented a graph in its *"Progress 2006"* report to illustrate the status and trends of phosphorus levels in Lake Champlain. Based on data collected during 2001-2005, three lake segments always met the in-lake phosphorus water quality criteria (Cumberland Bay, Shelburne Bay, and Burlington Bay) and four never met the criteria (Missisquoi Bay, St. Albans Bay, Northeast Arm, and South Lake A). Trend analyses over the period of 1990-2005 showed that nine segments had no significant trends (yellow wavy line), three segments had increasing phosphorus (red up-arrow) and one segment (Shelburne Bay) had decreasing phosphorus (green down-arrow).

The long-term monitoring data indicate that general reductions in phosphorus concentrations in the lake have not been seen as yet. Even with the accelerated implementation of phosphorus reduction measures by the Clean and Clear program which got underway in 2004, it is not realistic to expect these actions to produce immediate reductions in tributary phosphorus loadings or lake phosphorus concentrations. These changes may require several years or even decades, depending on how long it takes watershed and internal lake processes to adjust to better management and to purge the accumulated reservoir of phosphorus in soils and sediments.

The Vermont ANR will continue to work with the Lake Champlain Basin Program and other scientific partners to analyze the monitoring data and present ongoing assessments of the status and trends of phosphorus pollution in the lake and its watershed. This collaboration will include the production of a new State of the Lake Report and Ecosystems Indicators Scorecard in June 2008.



Status and trends of phosphorus concentrations in Lake Champlain. The five-year status indicates the extent of compliance with the in-lake phosphorus criteria for each lake segment during 2001-2005. The direction of statistically significant trends (increasing or decreasing) over the period of 1990-2005 is also shown for each lake segment. Figure is from the Lake Champlain Basin Program *"Progress 2006"* report. http://www.lcbp.org/progress2006.htm

DEC Watershed Initiative

The Problem

About 90% of the phosphorus pollution affecting state waters comes from a variety of non-point sources, including runoff from lawns, farms, streambanks, roadways, parking lots, construction sites. Unlike the piped, point source wastewater discharges that were so successfully managed over the last 30 years, non-point sources are difficult to isolate and treat. It is the collective impact of all our activities that results in non-point source pollution. Because we are all part of the problem, we all need to be part of the solution.

The DEC Watershed Initiative is key to: (1) educating people in each watershed about what they can do to help reduce pollution, (2) coordinating the various pollution prevention and reduction activities in the watershed, (3) engaging a broad, cross-section of the public in the watershed in establishing priorities and making decisions about the best way to manage and protect waters in the watershed community, and (4) preparing a river basin water quality management plan that reflects those priorities.

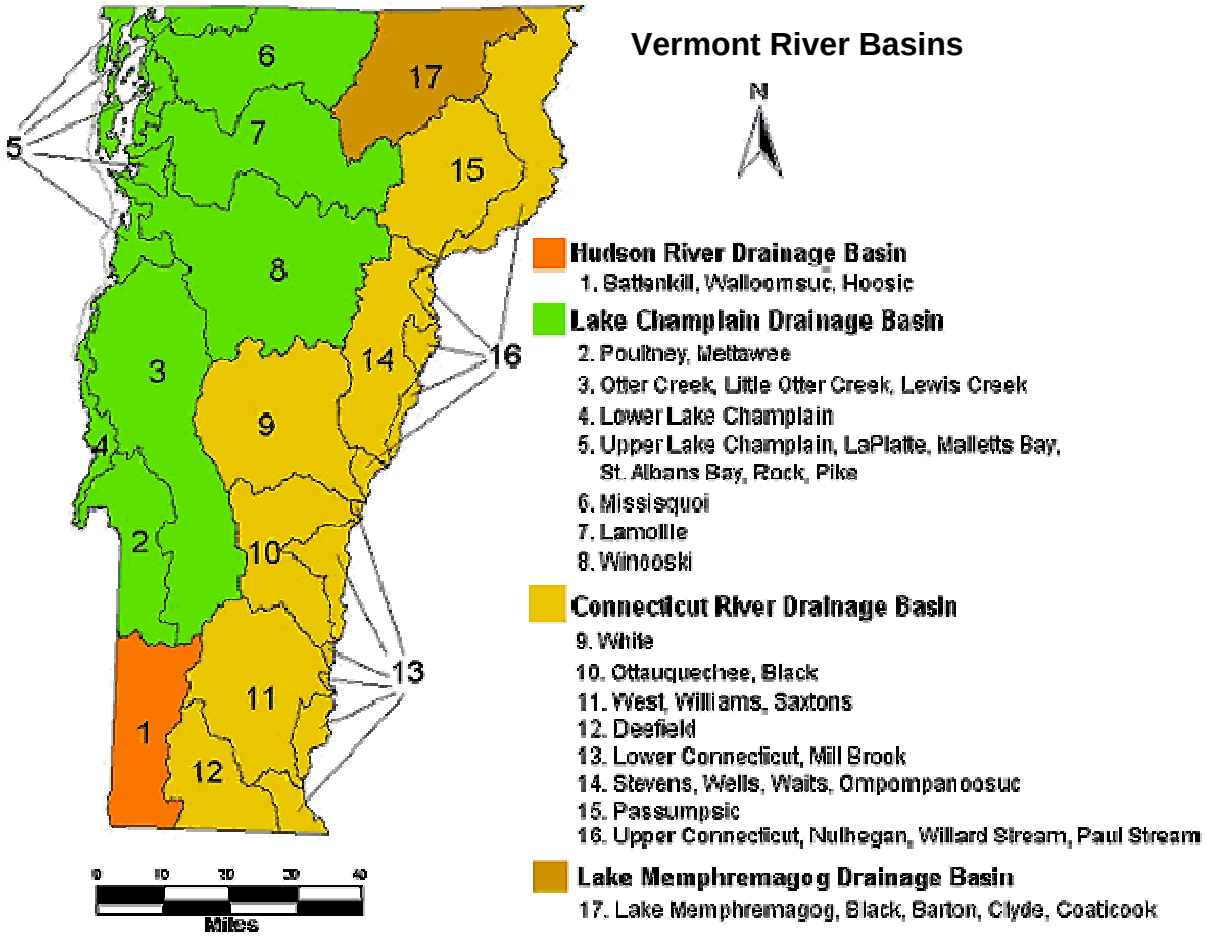
The Program

The Lake Champlain Phosphorus TMDL established phosphorus load allocations for each major lake watershed and included a general implementation plan containing major basin-wide program efforts that will be needed to achieve those allocations. Translating TMDL load allocations and river basin plans into real, “on-the-ground” actions requires a locally coordinated action process. Watershed Coordinators play a critical role in turning these plans into reality.

Watershed Coordinators lead the development of individual basin water quality management plans based on a public involvement process. They serve as a vital communication link between all the various state and federal agencies and local organizations that are contributing to water quality improvement efforts. They help educate individual landowners and business owners to prevent or abate non-point source pollution from their property. They facilitate the completion of projects, large and small, that correct locally identified problems and restore water quality. Watershed Coordinators in each major basin will help ensure successful follow-through and implementation of the Lake Champlain Phosphorus TMDL and other water quality plans throughout the state. Involving the public in the development of action-oriented strategies for protecting and improving water quality at the watershed, community level is both a recommendation in the Lake Champlain Phosphorus TMDL and a requirement of state law. The Agency of Natural Resources is committed to a river basin planning process that is action-oriented, and inclusive of a broad cross-section of the public in each watershed.

The DEC Watershed Coordinators develop partnerships with other organizations on projects designed to improve water quality such as buffer plantings, rain garden projects, and stream assessments and clean-up projects. The coordinators meet with municipal and regional authorities, conduct presentations and talk with the news media about the projects they are involved with. A considerable amount of each coordinator's efforts is devoted to preparing a water quality management plan that meets state and federal requirements.

The river basin water quality management plans required by statute involve in-the-field actions to restore waters. The public helps in developing strategies for water quality improvement and protection at the community and sub-watershed level in watersheds throughout Vermont. Watershed Councils are established in each basin to ensure a broad cross-section of public involvement .The Agency prepares a full report on watershed action planning for the General Assembly each year. The report provides detailed information about activities in these watersheds. The full report will be available online from the DEC Water Quality Division home page www.vtwaterquality.org



Program Accomplishments During 2007

Starting with the two Watershed Coordinator positions first approved by the General Assembly in 2005, DEC now has watershed action planning across Vermont in each of the four major regional drainages: Lake Champlain, Lake Memphremagog, Connecticut River, and Hudson River. The White River Basin Plan and the Poultney-Mettowee Basin Plan were completed and adopted by the ANR Secretary in 2002 and in 2005, respectively.

For much of 2007, there were seven watershed planning coordinators working to accelerate the development of state mandated basin plans. An eighth coordinator to be soon will replace a person who left the position in April 2007. In 2007, the DEC Watershed Coordinators engaged close to 2,500 persons across Vermont in forums and meetings designed to generate participation in projects, and developed or substantially assisted 100 watershed projects.

Consistent with legislation enacted in 2007, water quality management plans for the West/Williams/Saxtons basin and the Waits/Wells/Ompompanoosuc/Stevens basin are nearly ready to be released for public comment. Planning and project implementation work to control water pollution is underway in the basin areas noted above and in the Missisquoi, Northern Lake Champlain, Lamoille, Otter Creek, Batten Kill/Hoosic/Walloomsac watersheds. Work has begun with the Province of Quebec to begin addressing pollution problems in the Barton/Black/Clyde rivers that drain to Lake Memphremagog.

One required aspect of the river basin planning process is to develop recommendations for classification and water management typing. Once a river basin plan is finalized and adopted, a petition, consistent with the classification and typing recommendations, is prepared and submitted to the Water Resources Panel to be adopted as a rule. The first and only petition was submitted in 2003 and subsequently withdrawn. The water management types have not yet been adopted nor has the Panel prepared or endorsed practical guidelines for the Agency to use. This has slowed considerably the process of attaining fully completed planning and rule making actions for the basins.

Importantly, difficulties with water management typing have not slowed the action-oriented aspect of the watershed initiative in which the Watershed Coordinators are facilitating fixes to water quality problems and threats in each of the basins. We are actively working with Councils, stream teams, watershed groups, other state and federal agencies, land owners and other stakeholders. Some of the accomplishments for 2007 are listed below. A more complete enumeration of actions leading to or involving water quality remediation has been compiled and is presented in the annual report to the Legislature. The Agency will be working to find an alternative method to ensure that the goals of water management typing are carried out in a practical manner and expect to continue discussion on this issue with interested parties and the legislature."

Basin 1 - Batten Kill, Hoosic & Walloomsac

- Began initial outreach in this basin in early 2007 following the placement of a DEC Watershed Coordinator located in Bennington. Presentations to local watershed organization, community groups, local town officials and the regional planning

commission, focused on an overview of the basin planning program and most importantly, invited them to participate in the planning process.

- Held 14 informal public forums in 2007 to engage the public in the basin planning process and develop a list of community comments about local watershed assets, uses of local waters, water quality concerns and high quality water resources.

- Formed two local watershed councils to help facilitate the planning process in the basin. The Hoosic River Watershed Association will be working with community members interested in the waters in the Walloomsac and Hoosic rivers watershed. The Batten Kill Conservancy and Batten Kill Watershed Alliance will be working with those community members interested in the waters within the Batten Kill watershed.

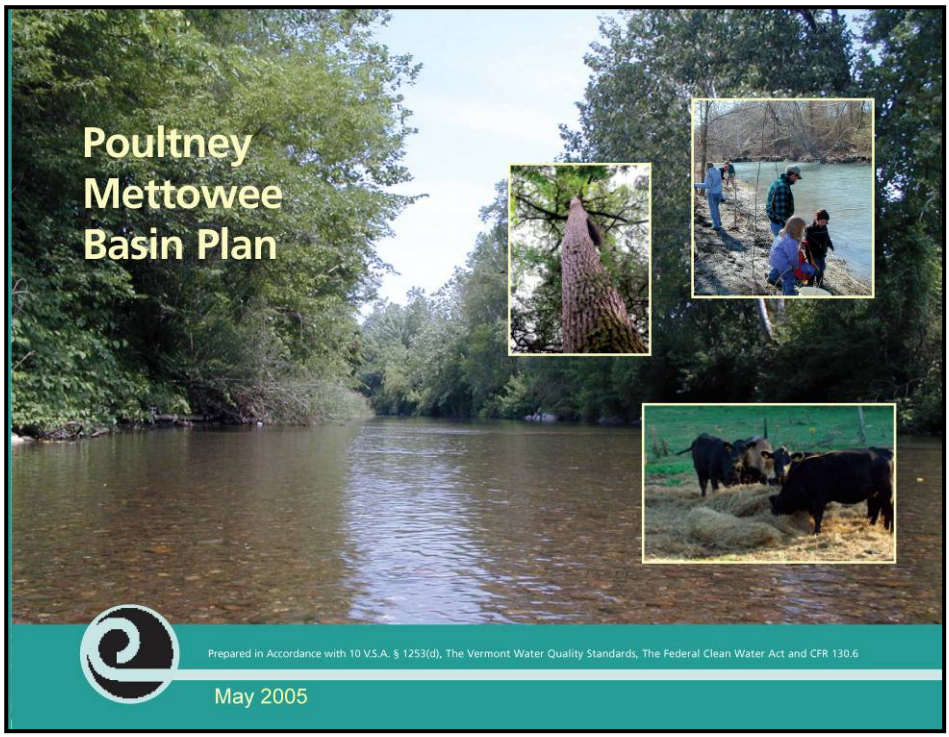
- Facilitated development of two Clean and Clear funded projects in the basin:
  1. The Southwestern Chapter of Trout Unlimited and the Batten Kill Conservancy developed a buffer planting campaign for the Batten Kill.
  2. The Bennington County Conservation District conducted a local Earth Day event for community members and families.

- Worked with the DEC River Management Program to administer the Pre-Disaster Mitigation money throughout the county.

- Worked with the Didymo Task Force and the local watershed organization to expand outreach to the Batten Kill community about how to prevent the spread of Didymo.

Basin 2 - Poultney & Mettowee

- Coordinated the printing of the final and ANR-adopted Poultney Mettowee Basin Water Quality Management Plan.



- Conducted Phase 3 Stream Geomorphic Assessment (SGA) on a priority reach identified for conservation easement on the main stem of the Castleton River.

- Reviewed biological, chemical, and physical monitoring data of waters in the basin considered for waterbody listing purposes.

- Implemented Better Backroads Project in the Town of Benson to correct erosion problems related to improper ditching and undersized culverts (completed) along backroads in Benson.

- Revisited Hubbardton River Tributary Headcut Stabilization Project to re-locate large woody debris dams that were displaced during spring high water inundation at the project site. This project was originally implemented as a means for streambank stabilization and aquatic habitat improvement through bioengineered techniques.

VYCC Crew Leader Carl Ciarcia loosens clayey soils in preparation for planting high bush cranberry on the banks of the Hubbardton River in Benson.

- Coordinated Mettowee River/ Flower Brook Thermal Monitoring and habitat improvement (ongoing since 2001 through the Poultney Mettowee Watershed Partnership).

- Helped with outreach for enrollment of riparian landowners in USDA-NRCS cost share programs, especially where Conservation Reserve Enhancement Program (CREP) can be combined with Conservation Reserve Program (underway). Planted over 1,000 trees along the Hubbardton River under the CREP Program.

Hubbardton Town Garage shows evidence of sediment migrating off site.

- Co-developed proposal to build a storage shed for the Hubbardton Town Garage sand pile to submit for the Municipal Stormwater Mitigation Grant funding through the Agency of Transportation.

Basin 3 - Otter Creek, Lewis Creek, Little Otter

- Coordinated Upper Otter Creek Water Quality Monitoring Program (ongoing since 2003) with the Rutland Natural Resource Conservation District.

- Coordinated East Creek monitoring and assessment project (water quality and physical monitoring related to flooding concerns and low dissolved oxygen due to

VYCC members pull a large tire from the Mussey Brook in this photograph featured on the front page of the October 11th, 2007 edition of the Rutland Herald.

hydroelectric operations in consideration of long term management planning).

- Coordinated Moon Brook Watershed Improvement Project with the City of Rutland, Department of Public Works and the Vermont Youth Conservation Corps. The Moon Brook (including Mussey Brook, a tributary) and Tenney Brook in Rutland City and Rutland Town were targeted for trash (debris) cleanup, brush roll and live stake plantings, and associated aquatic habitat restoration work. In addition, the crew installed approximately 50 optical brightener pads to be analyzed for illicit sanitary discharges into the storm drain sewer system. The crew pulled 20 tires and over one ton of trash from the Moon Brook alone.

- Reviewed biological, chemical, and physical monitoring data of waters in the basin considered for waterbody listing purposes.

- Co-coordinated Moon Brook River Corridor Planning Project (underway).

Members of the Stafford Tech Center's Forestry Program build portable skidder bridges in Rutland.

- Initiated the Rutland County Skidder Bridge Project which involves the construction of two portable skidder bridges for rental use by Rutland County loggers. These bridges will be leased to area loggers for placement over streams which will help reduce sedimentation and erosion due to silvicultural practices. Both of the bridges constructed for this project are now in use in Southern Rutland County.

- Coordinated with the Agricultural Basin Planner/Resource Specialist to organize several farmer discussion groups regarding basin planning and water quality protection in the Otter Creek Watershed. Several dairy and horse farmers who attended were solicited for input regarding agricultural strategies and invited to participate in future Otter Creek Agricultural Work Group meetings.

A VYCC crew member prepares to place rock on filter fabric laid out along a steep back road in the town of Lincoln.

- Initiated and co-coordinated a Regional Stormwater Education Program (RSEP) project with the Town of Brandon Planning Commission to pilot stormwater outreach and education efforts using a relatively large subdivision development (~ 60 house lots) as the target of outreach and stormwater mitigation.

- Coordinated a review of the Rutland Regional Plan, Water Resources Section and developed a process for updating the plan that included a presentation to the full Rutland RPC Commission at one of their monthly meetings.

- Assisted with the Addison County River Watch (ACRWC) Education and Outreach Project (ongoing). The ACRWC Education and Outreach Project will include a comprehensive assessment of Otter Creek, Little Otter Creek and Lewis Creek water quality conditions, greater citizen and community understanding of water quality conditions, watershed specific educational materials to inform protection and improvement activities, and a model for other watershed stewardship groups to follow. An education and outreach component of this project is underway.

- Collaborated with Town of Lincoln municipal officials and Better Backroads Program staff to develop a project using a VYCC crew to implement erosion control practices, including a step-pool gully stabilization project and back road improvements for a better backroads project in that town.

- Assisted DEC Lakes and Ponds staff in conducting spring phosphorus monitoring on several Lakes and Ponds in the Otter Creek Basin including High Pond (Sudbury), Elfin Lake (Wallingford), Spring Lake (Shrewsbury), and Silver Lake – GMNF (Leicester).

- Assisted with review of the proposed Otter Creek Hydroelectric Project located on the Otter Creek in Addison and Rutland Counties. Represented ANR during the evening scoping meeting in Proctor to listen to the issues and concerns of meeting participants as they pertain to the re-licensing of the Otter Creek Project (Vermont Marble Power Company – Omya, Inc.).

Representatives from ANR, FERC, and Omya view the Otter Creek Hydroelectric Facility at Huntington Falls in Weybridge.

- Participated on the resource team to brainstorm ideas and develop goals and strategies to "Make Better Use of the River" as part of the Otter Creek Public Forum on "Creative Communities Program."

- Assisted the Lewis Creek Association and primary partners in Watershed Conservation Planning in giving a joint presentation to ANR Secretary Crombie regarding collaborative efforts in managing the natural resources of high public value in the Lewis Creek Basin with the sub-theme of "educating while supporting local control."

The South Lake exhibits some of the most profound effects of phosphorus pollution, as evidenced by this photo taken on Lake Champlain in West Haven.

- Coordinated a Zoning Administrators Roundtable to address Municipal Actions for Water Quality Protection. This joint Rutland Regional Planning Commission and Upper Otter Creek Watershed Council meeting featured a presentation on "Municipal Actions to Improve Water Quality" with a focus on what towns can do to be more proactive with regard top wetland protection, stormwater management, floodplain management, and riparian buffers.

Basin 4 - Direct Drainages Emptying to Southern Lake Champlain

- Assisted with the formation of the South Lake Group. Stakeholders in the South Lake (Lake Champlain and lower Champlain direct drainages) met to discuss the status and action related to several issues including the lampricide treatment of the Lower Poultney River, invasive species, nutrient loading issues as per the Champlain Phosphorus TMDL and Clean and Clear, the Southern Vermont Nutrient Management Program, and municipal actions. Representatives from The Nature Conservancy, Lake Champlain Committee, Lake Champlain Restoration Association, Poultney Mettowee NRCD, and DEC Water Quality Division in attendance agreed to participate as the "South Lake Group."

Basin 5 - Various Direct Drainages Emptying to Northern Lake Champlain

- Continued work with the St. Albans Area Watershed Association on a campaign to reduce fertilizer use in St. Albans, which included a phosphorus-free fertilizer rebate program.

- Provided funding to develop the design and engineered plans for the installation permeable concrete side walks along the length of Taylor Park in St. Albans City to treat stormwater. The plans were used by St. Albans City to apply and subsequent receive a grant to install the sidewalk.

- Spoke at two out of state conferences on success of urban stormwater education programs in St. Albans.

- Continued to provide technical assistance for the installation of a stormwater bioretention structure in Hinesburg

- Initiated development of "*Don't P in the Lake and other lake friendly lawn care practices*" brochure with the help of the Lake Champlain Basin Program, Lake Champlain Committee, Cornell University and the University of Vermont. Over 4,000 brochures have been distributed by partners. Also worked with UVM Sea Grant Program to develop a display based on the brochure.

- Provided education about rain gardens and ecological lawn care. Efforts included a

Volunteers from the Missisquoi River Basin Association collect water samples in the Missisquoi River in Troy.

presentation, two display tables and assistance in development of a Vermont Rain Garden Manual.

- Assisted in placement of experimental units at the end of stormwater pipes to remove phosphorus from urban stormwater in St. Albans. The units will use iron slag, an end product from an electric arc furnace to remove phosphorus.

- Initiated and assisted in the development and implementation of an optical brightener detection survey in St. Albans City with the city's public works director and a science class at Bellows Free Academy in St. Albans.

- Provided technical support during the final stage of review of potential projects that will be paid for by an EPA grant to St. Albans City.

- Presented on development-related water quality problems in Franklin and Grand Isle Counties to 16 municipal officials in Swanton with other DEC staff and regional planning commission staff. Provided similar information at St. Albans City Planning Commission meeting.

Vermont Youth Conservation Corps Crew installs erosion control on a farm in Richford.

Basin 6 - Missisquoi, Rock & Pike

- Organized five Missisquoi Watershed Council meetings during the year to develop water quality management strategies for the watershed plan and introduce the work of the new Center for Clean and Clear.

- Continued regular contact with local media regarding meeting schedules, implementation activities, and particular issues of interest.

- Continued technical and coordination support for water quality monitoring projects: the ongoing Missisquoi River Basin Association work on the Missisquoi River and tributaries, and initiation of a new Rock River monitoring project with Friends of Missisquoi Bay, both of which are conducted in partnership with the LaRosa Laboratory at Vermont DEC.

Volunteers from Ben and Jerry's repair an eroding pasture in Highgate.

- Provided state watershed protection assistance funds for a streambank and wetland restoration project on Marsh Brook, the main tributary to Lake Carmi.

- Supported stream geomorphic assessment and project development in the Hungerford Brook and Rock River watersheds.

- Helped with the initiation of three projects in the area with funding through Clean Water Act Section 319 that concerned cover cropping, nutrient management planning and sediment discharge abatement. Sediment discharge abatement efforts under 319 are limited to the Rock River and Saxe Brook watersheds.

Lamoille Portable Skidder Bridge Project. Construction of bridges to be used to reduce erosion at logging operation stream crossings.

Basin 7 - Lamoille

- Developed and implemented Lamoille Portable Skidder Bridge Project with the Lamoille NRCD, VT FPR, and Hazen's Union Forestry Program. The project consisted of the construction of three portable skidder bridges of locally sourced and milled lumber which are made available to loggers at subsidized rates. A hands-on building and outreach workshop was also held. Portable skidder bridges can greatly reduce erosion at logging stream crossings.

- Initiated and led a VYCC crew in the installation of three stone-lined waterways to reduce erosion from a hayfield drainage to the Lamoille River in Morristown

- Developed designs, secured funded, and provided technical assistance to the Town of Walden in the construction of three Better Backroads grants to reduce erosion on gravel road..

Browns River, Westford. Trees for Stream student buffer planting.

- Initiated and directed Clean and Clear grant funding to design and conduct hydrologic modeling to stabilize a significant gully erosion site in the impaired Deer Brook waterway.

- Identified the gully erosion site, provided technical assistance to Johnson State College and contractor and construction supervision in the installation of a major stone lined waterway and riprap project to address a large erosion source to the Gihon River watershed.

Stevens Brook Watershed, Walden. Stone-lined ditch installation to stabilize eroding roadways.

- The Lamoille Farm and Forest Initiative (LVFFI) was launched with a public forum and completed directory. The LVFFI is an initiative to preserve the working landscape to enhance the economic vitality of productive farms and forests and improve watershed resident's connection to the landscape, thereby reducing subdivision of the working landscape, unplanned growth, fragmentation of wildlife habitat, and increased impervious surfaces and roads and associated urban runoff.

- High priority degraded wetlands have been mapped in an effort to restore these waters to provide sediments and phosphorus attenuation areas in the lower Lamoille watershed. Landowners and municipalities will be contacted and approached for potential wetland restoration projects.

- Served on an internal DEC and EPA work group that is overseeing the implementation of best management practices to reduce impacts of the enormous asbestos mine tailings runoff to adjacent wetlands and waterways.

- The successful Trees for Streams riparian buffer initiative has expanded watershed-wide organized by three NRCD offices in the lower, middle, and upper watershed. The Coordinator and NRCDs are prioritizing buffer establishment sites based upon compatibility with recently completed geomorphic assessments.

Lamoille River, Morristown. Stone-lined waterway installed by DEC and VYCC.

Basin 8 - Winooski

- Initiated a new innovative collaborative outreach, restoration, and monitoring effort with Winooski NRCD, Friends of the Winooski, DEC BASS Lab, partners from watershed non-profit organizations, municipalities, residents, and the private sector. The initiative will launch water quality and pharmaceutical and personal care product monitoring at waste water treatment facilities, rain garden construction, riparian buffer plantings, and watershed resident outreach efforts.

Allen Brook Watershed, Williston. Gully restoration with timber and stone check dams.

- Implemented of eight stone and timber grade control structures to address gully erosion in the Allen Brook watershed. Partners included DEC, VYCC, Winooski NRCD, and Town of Williston.

- **A**ssisted the Towns of Barre, Orange, Washington, and Berlin in preparing proposals, securing funding, providing technical assistance, and construction supervision in the implementation of 10 separate road best management practices to address flooding related erosion. Funding was provided through Better Backroads, FEMA Flood Mitigation, and VTrans Stormwater Mitigation grants.

Mid Winooski Urban Restoration Project. VYCC crew removing trash from Stevens Branch in Barre City.

- Worked closely with Barre Town officials in post flood remediation practices at several road-river conflict and erosion hazard sites.

- Initiated a new innovative collaborative outreach and restoration effort to address urban-related nonpoint source pollution in the Mid Winooski watershed. Partners include the Winooski NRCD, Friends of the Winooski, UVM Sea Grant Program, area schools, municipalities, and residents. Project specifics are described below.

U32 High School student creating "watershed rain barrel art." Painted rain barrels were distributed to urban residents as part of the Mid Winooski Urban Restoration Project.

- Supported a DEC and VYCC crew in cleaning up trash from two miles of stream in Barre City.

- Five timber and stone grade control structures were implemented to address gully erosion, in the Honey Brook Watershed, Barre Town.

- Approximately 700 riparian trees, shrubs, and cuttings were established, invasive species removed, and two stone-lined waterways were installed along the North Branch by DEC, YCC, and City of Montpelier.

- Distributed 60 rain barrels to urban residents and provided education to two school groups to help address urban related runoff. Partners included DEC, Winooski NRCD, Friends of the Winooski, UVM Sea Grant Program, and U32 and Spaulding High Schools.

Rain garden installation with DEC, UVM Sea Grant Program, Barre City and VYCC.

- Installed five rain gardens in the Barre, Berlin, and Montpelier areas with watershed partners. Partners included DEC, UVM Sea Grant Program, Winooski NRCD, Friends of the Winooski, municipalities, schools, the Master Gardeners Program, and VYCC.

- Established riparian buffer along several hundred feet along the Winooski in Cabot. Partners included DEC, Winooski NRCD, Friends of the Winooski, Town of Cabot, and watershed volunteers.

- Established riparian buffer along several hundred feet along the Winooski on land owned by the Town of Marshfield. Partners included DEC, Winooski NRCD, Friends of the Winooski, Town of Marshfield, and watershed volunteers.

Basin 10 - Ottauquechee & Black

- Provided support and assistance to the Southern Windsor County Regional Planning Commission (SWCRPC) to initiate a Phase 1 Geomorphic Assessment of the Black River and its major tributaries and a Phase 2 assessment on selected reaches.

- Assisted in initiating water quality monitoring for total suspended solids on Lake Rescue feeder streams to determine sediment loading to Round Pond.

- Assisted and funded a buffer planting to re-vegetate a ravine located in a park in the Town of Springfield following CVPS stripping the banks of vegetation.

- Participated in the first Black River Festival.

- Created an initial contact list and began providing information on the basin planning process in Basin 10.

Unidentified pollution in Ottauquechee River at the Elm St. Bridge.

- Assisted the Windsor Paradise Park Commission with erosion and sedimentation problems in the Paradise Park wetland complex.

- Assisted the Town of Windsor with planning and selecting projects for Eurasian milfoil control and assist wetland protection on town property.

- Worked with SWCRPC and Ottauquechee Natural Resources Conservation District on establishing a native plant nursery on land donated by Luzenac America.

- Provided assistance in the coordination of the Black River Stream Geomorphic Assessment and Basin 10 flood hazard mitigation updating and ordinances.

Basin 11 - West, Williams and Saxtons

- Completed the Draft Basin 11 Water Quality Management Plan and prepared it for public distribution and comment meetings.

- Provided support and assistance to the Windham County Natural Resources Conservation District (WCNRCD) to initiate and continue Stream Geomorphic Assessment work on the West River, Rock River, and Ball Mountain Brook.

- Worked with the Windham Regional Commission and the WCNRCD to complete preliminary typing for Basin 11 and met with 8 towns to present typing proposals.

- Held six public meetings with the WCNRCD to present their Basin 11 plan for public comment.

- Held meeting with the towns of Newfane and Dummerston and interested citizens on the issues facing the Rock River swimming areas and applied for a Transportation Enhancement grant to conduct a feasibility study of the project.

- Partnered with the West River Watershed Alliance to begin basin plan implementation. WRWA is presenting septic system maintenance workshops, continuing the water quality monitoring program and working with the Town on Londonderry on bacterial contamination in the West River.

- Provided information and comments to ANR Planning and Legal staff on a conflict between wastewater rules and Class A watershed protection in Water Quality Standards.

- Assisted and resolved an agriculture land use conflict between two farmers and the USACE involving blocked drainage ditches near a wetland on the Williams River.

- Assisted with the coordination of the Saxtons River Stream Geomorphic Assessment and Basin 11 flood hazard mitigation updating and ordinances.

Basin 12 – Deerfield

- The basin planning process has not begun for the Deerfield River, however two projects were initiated in the Deerfield Basin:
  1. Supported development and distribution of a *Deerfield River User Guide and Map.*
  2. Supported development of an educational watershed placemat was developed for the Deerfield River. The placemat includes a watershed map and fun games for children.

- Served as DEC representative on the Deerfield River Enhancement Fund review committee Annually these funds are distributed to projects that meet the goals of the Fund program.

Basin 13 - Direct Drainages to the Lower Connecticut River

- Worked with the Town of Brattleboro Selectboard and Planning Commission to pass interim zoning protecting the Whetstone Brook floodplain and flood hazard area throughout West Brattleboro from further encroachment and development.

- Held Crosby Brook meetings with the Town of Brattleboro, the Putney Road Business Association and VTrans to begin addressing the sediment impairment in Crosby Brook.

- Planned work and applied for grant funding to address erosion along Black Mountain Road on Crosby Brook.

Conducting an invasive plant survey on Lowell Lake.

- Began stream geomorphic assessments on Crosby and Whetstone Brooks.

- Initiated and funded a floodplain outreach and education project on the Whetstone Brook.

- Participated in local events associated with Clean and Clear Day.

- Assisted WRWA in planning a water quality monitoring project for the Whetstone Brook to identify sources of bacterial and VOC contamination.

Basin 14 –Waits, Wells, Ompompanoosuc and Stevens

- Completed a draft plan for Basin 14 in 2007, working closely with four watershed councils representing each of the Waits, Wells, Ompompanoosuc and Stevens river watersheds. Twenty watershed council meetings were held in these four watersheds.

- Worked closely with the Ompompanoosuc River Watershed Council to identify sources of E. coli causing the impairment of the Ompompanoosuc River in West Fairlee and Thetford.

- Worked with the Stevens River watershed council to complete sediment and phosphorus storm event sampling in the Stevens River Watershed and worked with the Wells River Watershed Council and Blue Mountain School to initiate a volunteer monitoring program on the Wells River.

- Worked with local groups to implement projects in the watershed, including a culvert replacement in Groton and planting trees along the South Branch of the Waits River.

- Led a pair of field trips on the fluvial geomorphology of the Waits River as a component a geomorphic assessment in progress in this watershed in cooperation with the Corinth and Bradford Conservation commission and Waits River Watershed Council.

- Worked with the Ompompanoosuc Rive watershed council to present results from volunteer E. coli monitoring in a public meeting.

Basin 17 – Lake Memphremagog, Tomifobia and Coaticook Rivers

- Initiated the watershed planning process in the Lake Memphremagog, Tomifobia and Coaticook river basins. A series of meetings was organized early in the year to assist local residents in forming the Memphremagog Watershed Association. This group now has over 50 members.

- Hosted a series of four public forums in the watershed to officially kick off the watershed planning process in this basin. After these forums the first watershed council meeting was held in October and the council is forming with representation from a number of interest groups and residents from across the watershed.

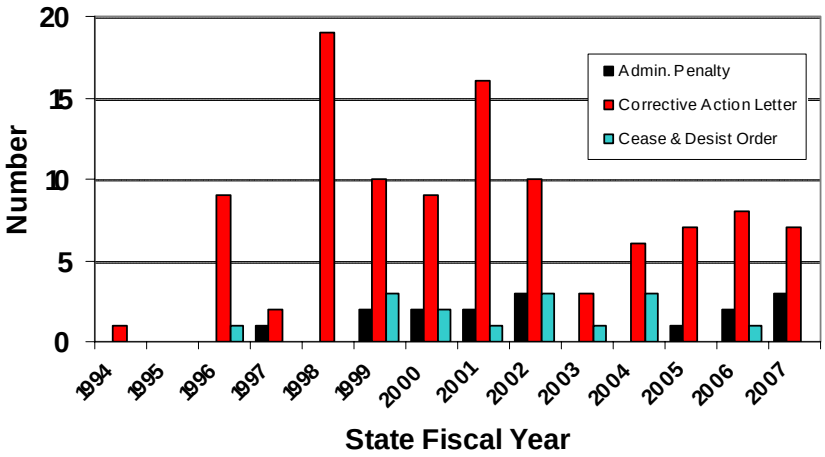
- Cooperated on a number of educational events, including: a presentation on shoreline management practices to benefit water quality and aquatic habitat, and a follow up field workshop to look at a number of shoreline sites and how these could be improved; sponsoring a Vermont Invasive Patrollers training; completing a shoreline restoration project on Lake Memphremagog; and initiating a lake and shoreline assessment of Lake Seymour with the Lake Seymour Association and road survey to identify a number of road improvement projects to reduce erosion.

Agency of Agriculture, Food and Markets
Clean and Clear Programs

Accepted Agricultural Practices Program

Accepted Agricultural Practices are statewide restrictions designed to reduce non-point pollutant discharges through the implementation of improved farming techniques and land management practices rather than investments in structures and equipment. Accepted Agricultural Practices are intended to reduce, not eliminate, pollutants associated with common agricultural activities. The AAPs have been in place since 1995 and the rules were significantly revised in 2006. AAPs require, among other things, minimal buffers along surface water and around wells, management of production areas to prevent discharges, standards for manure storage, application and management, minimum streambank standards, soil testing and standards for the protection of ground water quality. AAPs apply to all farm operations, regardless of type or size.

Accepted Agricultural Practices Enforcement



In the spring of 2007, the Agency focused on enforcing the revised buffer standard requiring that all farms must have a 10 foot buffer from the top of a streambank. The setback cannot be tilled or have manure applied to it. Based on initial compliance efforts it is estimated that nearly one in three farms visited had areas

that needed to have buffers established. Another newly revised AAP rule is that streambanks must be maintained in their natural vegetative condition except at defined areas such as livestock crossings. The intent of this requirement is to reduce erosion associated with livestock access to surface water. The Agency is actively working with farms to ensure implementation of this new provision of the AAPs.

The Agency has conducted over 900 AAP investigations from the inception of the program in 1995 and of these, 115 were conducted in 2007. Investigations are conducted both in response to complaints received from the public and in the course of conducting routine AAP compliance checks. Over the past 5 years, from 2003 to October 2007, violation rates have remained relatively low and have ranged from 8% to 14%, for an 86% to 92% compliance rate. The violation rate for 2007 was 9% which included three administrative penalties and seven corrective action letters. To keep the regulated community informed and up to date on AAP requirements, presentations on the regulations are made at agricultural meetings and articles on various aspects of the AAPs are included in the Agency's publication *Agriview*. In addition, ARMES Division field agents provide technical assistance on AAPs while conducting routine AAP compliance checks on agricultural operations.

Pesticide and Groundwater Monitoring Program

The Program

In 1986, The Vermont Agency of Agriculture initiated the Pesticide and Groundwater Monitoring Program for pesticides and nitrates. This program has completed 21 years of sampling groundwater for farm operators and their neighbors with drinking water supplies adjacent to agricultural lands. The Agency has sampled a total of 1,593 private drinking water supplies in 184 towns representing each of Vermont's fourteen counties. Farm wells account for 66% of all wells sampled and non-farm, neighboring wells account for 34%. For the five year period from 2003 to 2007, 618 drinking water wells were sampled. A total of 1,566 individual water samples were collected and analyzed by the Agency of Agriculture.

The Pesticide and Groundwater Monitoring Program was founded to investigate the quality of drinking water on Vermont farms because of concern for the potential for groundwater contamination by pesticides. Results show the occurrence of nitrate in groundwater is far more common than the detection of pesticides. The recognition of nitrate in groundwater as a significant agricultural water quality concern stimulated the merger of program priorities and water sampling activities between the Pesticide Program and the Agricultural Non-Point Source Control Program. The Agency of Agriculture now conducts surface water and groundwater sampling projects and water quality investigations as part of a coordinated Agricultural Water Quality and Resource Management Program.

Nitrate and Herbicide Results

In 2007 the program tested 181 wells and collected 234 samples. The results show that 108 of 181 wells tested had positive detections for nitrate. 40% of the wells tested had no detections for nitrate. 23 wells exceeded the drinking water standard of 10 ppm. This represents a short-term violation rate of 13%. The herbicide results show that 28 wells had positive detections for one or more herbicides. There was only 1 drinking water well with a detection of herbicide that exceeded a state or federal drinking water standard during 2007.

Since 2003 the program has tested 618 wells and collected 1,566 samples. 315 of 618 wells tested had positive detections for nitrate. 49% of the wells tested had no detections for nitrate. During this most recent five year period, 73 wells exceeded the drinking water standard of 10 ppm at some point during this time. This represents a long term violation rate of 12%. The herbicide results show that 71 wells had a positive detection for one or more herbicides. This represents a detection rate of 12% and violation rate of less than 1%.

Five Year Summary of Nitrate and Herbicide Results
Data represents a total of 1,566 individual drinking water samples analyzed by the Agency

2003 - 2007	# Wells Sampled	# Wells Not Detected	# Wells w/ Detections		# Wells Above Standard
Herbicide Results	618	547	71		1
		(88%)	**(12%)**		**(<1%)**
	# Wells Sampled	**# Wells Not Detected**	**# Wells Below 5 ppm**	**# Wells 5 - 10 ppm**	**# Wells Above 10 ppm**
Nitrate Results	618	303	197	45	73
		(49%)	**(32%)**	**(7%)**	**(12%)**

Program Status and Trends

A total of 63 new well sites were sampled during 2007. This represents a decrease in the number of new wells sampled for the year but an increase in the proportion of farm wells sampled. The trend that developed in recent years of sampling a larger percentage of non-farm wells has been reversed. This occurrence is significant for two reasons: 1) The revised AAP Regulations (April 2006) and the new MFO General Permit (February 2007) have created additional opportunities for Agency of Agriculture and Natural Resource Conservation District staff to conduct on-farm assessments and provide technical assistance to farm operations for compliance with water quality requirements; and 2) The Agency of Agriculture has received a smaller number of requests for water sampling from non-farm well owners based on complaints that farm operations are contaminating groundwater.

To accomplish the mission of the AAP, MFO and LFO Programs, the active focus of the Agency's groundwater program has shifted to conducting water sampling related to pre/post construction evaluations of certified manure storage structures, barnyards and leachate collection systems. Groundwater sampling is also conducted to assess the effectiveness of nutrient management plans at preventing groundwater contamination from field application areas and crop production practices. These types of water quality sampling projects require a greater focus on the re-sampling and follow-up assessment of existing well sites as opposed to a focus on searching out new well sites.

The outreach efforts for AAP education and awareness conducted by the Natural Resources Conservation Districts are shifting to projects aimed at reaching non-dairy, livestock operations and practices. This initiative creates the opportunity to conduct farm assessments and groundwater testing for agricultural land owners that are required to comply with the AAPs but may not be aware of the conditions that apply to their operations. The nitrate violation rate (the number of wells above the standard of 10 ppm) showed a 2% decrease for 2007. This improvement is reflected in both the one and five year data. The herbicide detection rate showed a 1% decrease for the 2007 data. This one year change is not yet reflected in the 5 year summary data.

Medium Farm Operations Program

The General Permit for Medium Farm Operations (MFO) parallels the current Large Farm Operation Rules (LFO) Rules to create a seamless regulatory program that strives to protect water quality while maintaining farm viability. The definition of a Medium Farm Operation is based upon the number of mature animals on the farm. Over 90% of all MFOs in Vermont are dairy farms, which by definition means they have between 200 and 699 mature dairy animals. There are animal number thresholds that trigger any type of livestock operation (poultry, swine, etc) for coverage under the state's MFO General Permit.

The development of the state's three-tiered approach to water quality has created a logical progression of regulatory oversight to help any farm as it grows in size. The MFO General Permit is designed to mimic the federal EPA water quality regulations for Confined Animal Feeding Operations (CAFO). The MFO Rules and General Permit require farms to implement practices that prevent the discharge of agricultural wastes from the farms production area to waters of the state. The General Permit also requires all MFOs to operate under a NMP and to maintain a 25-foot perennial grass buffer that cannot receive manure applications on all fields adjacent to surface waters. The rules represent a level of farm management above and beyond the AAPs and are more stringent than the federal CAFO rules.

Program Implementation

In 2006-2007, the Agency completed a preliminary visit of roughly 65% of all MFOs identified to date, in attempts to prepare the farms for the new regulatory framework, and to provide technical assistance to farms working on improving practices related to water quality.

On February 13th, 2007, the proposed General Permit for Medium Farm Operation was signed by the Secretary of Agriculture. The approval of the state General Permit provided 6 months for all current MFOs to seek coverage under the permit by submitting a Notice of Intent to Comply (NOIC) to the Agency. The final date to send in the NOIC was August 13th, and we have received 100% of all identified MFO NOICs.

Upon submission of a farm's NOIC, the Agency has 18 months to conduct an inspection of all covered MFOs to determine if the farm is in compliance with the permit. The Agency began inspections in late August, and this process will continue over the next 18 months. Thus far, ten inspections have been completed and two violations of the General Permit were identified. The farms in violation have received letters detailing the violation. A follow up inspection will be conducted to assure the violations have been corrected. The greatest challenge for many MFOs will be meeting the new standards where geography and existing barnyard design make it difficult

to install structures necessary to control and properly treat runoff and silage leachate. The Agency will continue to inspect and enforce the provisions of the MFO general permit while providing technical assistance in order to resolve these problems.

Future Program Progress

The MFO program has generated increased enrollment in the other conservation programs offered at the Agency, such as the nutrient management program, the best management practices and alternative manure management programs, the farm agronomic practices program and the conservation reserve enhancement program. Many MFO farms have chosen to enroll in these programs in preparation for meeting the compliance requirements of the general permit. These programs will continue to help with technical assistance to medium sized farms however from the MFO staff this year will be mainly focused on the regulatory inspection of these farms. In the prior year most of the known MFOs were visited by the MFO staff and offered the technical assistance they might have needed to meet the regulatory requirements, it is now time to assure that the operation and maintenance procedures are in place as the permits are in effect. Furthermore, the EPA has already noted they are anticipating inspecting a few selected medium sized farms in Vermont this coming year.

Large Farm Operations Program

The Vermont Agency of Agriculture administers a state authorized water quality program, known as the Large Farm Operations (LFO) program. The goal of the program is for all larger farms to have structures in place in the production area for managing wastes, and nutrient management plans to appropriately land apply these wastes. Farms that are managed in compliance with these requirements cannot have discharges, and therefore would not need a federal National Pollutant Discharge Elimination System (NPDES) permit. The state LFO program was authorized in 1995. Under this state program, Large Farm Operations are eligible for individual permits only. There is no state general permit for large farms. To date, all large farms (700 + mature dairy livestock, e.g.) have received state LFO permits. Of permitted LFOs at this time, 16 are dairy producers, 1 is an egg producer, and there is 1 beef producer.

This year the Agriculture Agency began regulating the state's medium sized farms to a greater standard than is expected of smaller farms. In the process of determining which farms fall in to this 'Medium Farm' category, we have discovered some farms that are near the LFO threshold. Most will be regulated as Medium Farms, however some may be required to apply for the LFO permit due to the fluctuation of the herd size to assure they can freely do business while complying with the regulations. As a benefit to farms of this nature, the LFO rules have recently been revised to mirror many requirements of the Medium Farm Rules with additional restrictions such as controlling odor, noise, traffic, flies and other pests for the large farms.

LFO Regulations

In 2007 the revised Vermont Large Farm Operations Rules were finalized. The revisions in the rule are aimed at bringing LFO standards up to the more recently adopted MFO standards, and to address new statutory requirements for advisory groups (when new farms are proposed), siting and setback standards for new barns, groundwater investigation procedures, update the operation and maintenance requirements and update the engineering and design standards to the current NRCS technical practice standards. Several of these revisions are above and beyond those required by the Concentrated Animal Feeding Operations (CAFO) rules, the federal equivalent to the LFO standards in Vermont. For instance, CAFO does not require a farm to have a nutrient management plan unless there is a discharge from a field to surface water, the LFO requires all of these farms to have an up to date NMP on site. CAFO does not regulate groundwater and the LFO rules do. Lastly, under CAFO a farm can begin building a barn without a CAFO permit and then still be denied the permit whereas in VT the permit must be approved before the farm can begin building the barn.

Assistance, Compliance, and Enforcement

The Agency completed on-site inspections of ALL permitted LFOs during the spring and early summer. Some of these resulted in recommendations being made to improve operations, and ten resulted in penalties with compliance schedules to remedy violations. Each permitted LFO

received at least one additional follow up visit during the summer to ensure necessary operational changes and continued compliance under their individual permit. Many of the permitted farms also received significant, technical assistance through out the summer and fall to help improve waste treatment system structures that had become outdated. At this time, all but one of the farms have remedied all violations of their permits.. This last farm has received funding and is in the process of resolving the structural deficiencies of the current waste management system.

The Vermont Department of Environmental Conservation (VT DEC) initiated formal inspections this year, as the ANR is the state's delegated authority for the federal Concentrated Animal Feeding Operation (CAFO) program. The VT DEC staff introduced themselves and the federal program to the farmers, answered the farmers' questions, and documented their observations. Due to state water quality law, permission of the farmer was required for the VT DEC staff to enter the property. Only one large farm operator denied access to VT DEC. With this one exception, the initial inspections were successful and helpful for the farmers. VT DEC also conducted follow up visits to affirm that required improvements had been completed.

For the first time in Vermont, the US EPA conducted inspections on four of the state's permitted large farms. EPA selected the sites, and all four were located in the northern Lake Champlain Basin. No more than 24 hours' notice was given to the farms. No violations were observed. Vermont is now on schedule to have several farms inspected each year by federal US EPA enforcement staff.

Future Program Progress

The LFO coordinator continues to work with farmers who are interested in obtaining an LFO permit for future expansions. With the MFO program and its staff providing outreach and education to farmers that were not part of the initial large farm sector, the Agency now has additional, earlier opportunities to connect with farmers who may be considering consolidation, expansions, and construction.

No new large farm facilities were permitted this year, but many amendments were sought and issued. However, one permitted dairy LFO, which has been operating near or below the LFO threshold for some time, decided to formally withdraw from the LFO program. Simultaneously, the farm submitted an NOIC, seeking coverage under the state's general permit for MFOs.

Best Management Practices and Alternative Manure Management Programs

Phosphorus on farms is usually found in the production area and the fields. The production area has the greatest potential for discharges on a farm since the majority of the manure, silage, and milkhouse waste is stored there. The cost to install structures that prevent discharges is much greater for the production area compared to field practices. The Best Management Practice (BMP) and Alternative Manure Management (AMM) programs were established to help defray the farmer's costs and improve water quality by installing a myriad of practices designed in accordance with state and federal water quality standards and regulations. The BMP Program is closely tied to the federal funding program offered by the USDA Natural Resources Conservation Service known as the Environmental Quality Incentives Program (EQIP). By working with EQIP, state dollars combine with federal dollars increasing the overall funding available to farmers and the likelihood that structures to improve water quality are implemented. The AMM projects are demonstration projects designed to develop new waste management technologies that will help to reduce pollutants leaving the production area or minimize impacts such as odor to adjacent landowners.

Program Progress

The BMP Program contracted 560 practices in 2007 for a total state allocation of $1,396,108 on farms of all sizes throughout Vermont. These BMP practices range from fencing for livestock exclusion from water sources to constructing manure storage and silage leachate treatment systems. In addition, eight AMM practices were contracted for $340,211 in fiscal year 2007. These eight practices include the construction of two anaerobic digesters, a roller solids separator, a post digestion and separation settlement basin, a rotary drum solids processor, and a silage leachate waste water treatment strip. Preliminary planning began on three additional anaerobic digesters, a sand settling lane, two milk house waste water treatment systems, and a number of silage leachate waste water treatment systems. Overall, the Agency was granted $1.8 million for these two programs and has allocated $1,736,319. As of October 2007, the Agency has made payments totaling $636,547 on practices contracted in fiscal year 2007 which have been completed. This equates to a 36% turnaround time to contract and implement a practice in less than one year.

Program Future Progress

Currently the Agency of Agriculture provides technical assistance to farming operations utilizing, or considering, manure digestion technologies. There are six anaerobic digesters online in Vermont and an additional six farms that should be online in 2008. Another six are expected to

be online by 2009 for a total of 18 statewide. None of these systems are identical and most are built from overseas or out of state companies so having an on the ground local technical assistance network is vital to keeping these operations moving forward as nearly all have experienced some sort of technical difficulty. Not all systems are based on the same media either. For example, one of the digesters solely uses crops to feed the system rather than manure. Some digesters are aimed at producing energy while others are creating bedding materials that can be utilized on the farm. Through the increased enrollment in the AMM program, it is very clear that farms are moving in the direction of utilizing on-farm resources to reduce long term inputs and costs associated with farming.

Nutrient Management Grant Incentive Program

The Nutrient Management Incentive Grant Program was developed to assist farms with nutrient management plan development and implementation, and to provide grants to establish nutrient management education programs for the farming community. The goal is to provide sufficient financial assistance as well as technical support to Vermont farms of all sizes and livestock type to enhance resource utilization on the farm to improve water quality.

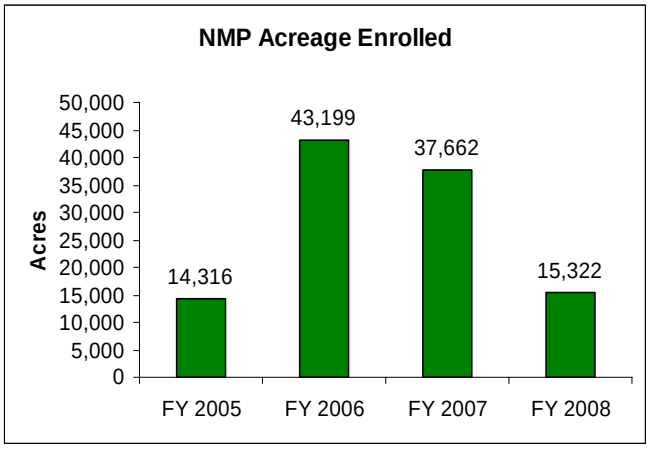
The process of nutrient management utilizes proper nutrient distribution on crop land and farm management techniques in order to closely match crop needs and limit nutrients entering water resources. This concept is achieved by testing manure and soil nutrient levels and then creating crop recommendations for manure and/or fertilizer applications on individual fields. Other tools that indentify erosion or phosphorus loading potential using computer modeling equations are run on individual fields to best determine where the critical areas are on the farm. For instance, a field that is prone to greater soil erosion should be in a hay rotation more often and a site with above optimum soil test phosphorus levels should have very little or possibly no additional phosphorus applied to it. Site-specific farm management techniques such as these can lower the threat of phosphorus entering surface water and are all summarized for a farm in a nutrient management plan.

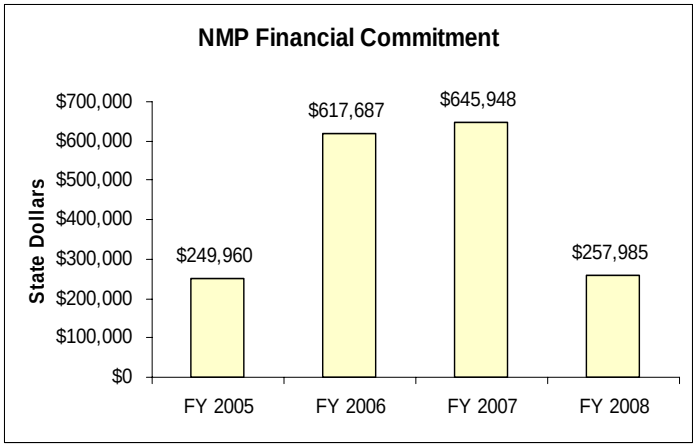
Phosphorus is often adsorbed to soil particles so reducing soil erosion is very important to manage phosphorus in the watershed. Practices such as these can help reduce erosion and are often the types of field practices recommended in a nutrient management plan:

- Crop rotation (switching between corn and hay to offer more soil erosion protection and improve organic matter which dually helps to reduce erosion over time).
- Cover cropping (re-establishing vegetation after harvest in the fall to reduce erosion during winter and spring runoff events).
- Conservation tillage (plowing along contours to reduce the potential for gully and sheet erosion).
- Strip cropping or contour planting (planting an erosion reducing crop such as hay between crops associated with more erosion, like corn, and a water source).
- Vegetated buffers (shrubs, trees or grass that are planted to help filter runoff from farm fields before it enters a stream).

Program Progress

The NMP incentive grant program has had great success in enrolling farmers. From its inception in 2005 to the end of the 2007 fiscal year, 178 contracts have been awarded into the program and are eligible to receive reimbursement for implementing NMPs on more than 95,000 acres statewide. The total state funding allocation for these 178 contracts is $1,513,595, which includes the cost of development and then three years of update maintenance costs. So far 84 contracts totaling roughly 51,506.2 acres have completed the process of developing a nutrient management plan and were reimbursed for the plan development costs. Of these, 13 contracts have completed an annual update and received the reimbursement payment from the Agency. In 2007, 81 contracts were approved for cost-share funding pending the approval of the final nutrient management plan. A total of $645,948 was allocated to the 81 plans, which includes the development and update payment amounts.





Future Program Progress

Specific information pertaining to these plans has been recorded to track progress and attempt to measure the success of nutrient management planning in Vermont. The type of information recorded includes the number of acres with nutrient management plans, soil test phosphorus levels, and the acres of farm land meeting specific erosion requirements. With this information being tracked over time, the Agency hopes to document trends in increased acreages under NMPs, a balance in soil test phosphorus levels among all fields on a farm, and an increase in the acres managed to the tolerable soil loss rate.

This program has been very successful in enrolling a number of farms, partly because as of April 2008 all medium and large size farms must operate under a nutrient management plan. To meet this demand, the private sector has increased the capacity to create NMPs and created more efficient processes to collect and assimilate the data into uniform plans. It is expected that NMPs will arrive at the Agency on a regular basis in the next year as much of the NMP work is currently in progress by commercial enterprises and farmers. However, with more than 1,100 dairy farms in Vermont, there is still plenty of need for the NMP incentive grant program because as of January 2008 only 205 contracts have been enrolled in the program. Continued emphasis on the importance of nutrient management is needed by all agricultural field technical assistants to increase the level of water quality protection in Vermont.

Farm Agronomic Practices Program

The Problem

Manure and fertilizers contain essential, or macro, nutrients including nitrogen, phosphorus, and potassium, required for plant growth and crop production. When applied, phosphorus becomes a concern if it leaves crop land and enters surface water where it can cause eutrophication and contribute to algae growth.

Nutrient Management Plans (NMPs), and their implementation, are a crucial tool in mitigating phosphorus loss to surface waters. All Medium Farm Operations (MFOs) and Large Farm Operations (LFOs) are required to implement NMPs which meet the requirements of the USDA-NRCS '590' planning process according to their permits. In addition, any farm, including Small Farm Operations (SFOs), receiving state or federal financial assistance for waste management system improvements must also implement a '590' NMP.

As phosphorus primarily enters surface water attached to soil particles, a NMP relies heavily on the identification of critical source areas, for instance fields with excessive erosion, and the implementation of specific soil-based conservation practices to remediate the concern and meet the requirements of the '590' planning process (for instance all fields must meet the tolerable soil loss level of 'T').

While the NMP Incentive Grants program provides initial financial assistance for the development and update of the plan, there is a growing need for further financial assistance to implement the necessary soil-based conservation practices.

The Program

The goal of the Farm Agronomic Practices (FAP) Program is to provide Vermont farms with state financial assistance for the implementation of soil-based conservation practices that improve soil quality, increase crop production, and reduce erosion and agricultural waste discharges.

The FAP program provides for:

- Cover cropping ($20/acre)
- Conservation crop rotation ($25/acre);
- Strip cropping ($24/acre)
- Cross-slope tillage ($10/acre)

Cover cropping is the establishment of a seasonal (winter) cover on annual crop land; strip cropping is the management of row crops, forages, small grains, and/or fallow land in a systematic arrangement of equal width strips across a field; conservation crop rotation is the growing of multiple crops in a recurring sequence on the same field; and cross-slope tillage is a system of crop rows on planned grades (with the contour of the field). Each of these practices helps to lower erosion, therefore limiting phosphorus transport to surface waters, improves soil tilth, and can help increase crop production.

The FAP program also provides for NMP maintenance and update ($2/acre) where a farm is no longer eligible for state or federal assistance and for educational and instructional activity grants (up to $1,000/activity). The goal of the educational and instructional activity grants is to increase farmer and citizen awareness on the impact of agriculture on water resources and on federal and state water quality regulations for agriculture.

Program Accomplishments During 2007

While four practices are available through the FAP Program, applicants have only sought to enroll in cover cropping and conservation crop rotation. In total, 24 farms participated in the FAP Program in FY07, enrolling 1,572.2 acres, for a financial commitment of $32,314.10.

Nineteen farms enrolled 1,397.9 acres in cover cropping (a $27,956.60 financial commitment) and five farms enrolled 173.4 acres in conservation crop rotation for a financial commitment of $4,357.50.

While the FAP Program also encourages continued assistance for nutrient management plan update/maintenance and outreach on agricultural water quality impacts and agricultural water quality regulations through educational and instructional activity grants, there has been no enrollment in either of these areas.

Indicators of Progress

Demand increased for cover cropping with 31 farms enrolling so far in FY08 (up from 19 in FY07). Cover crop enrollment increased to 3,078.7 acres and the financial commitment for this practice has increased to $61,574.80 (FY08).

Applications for conservation crop rotation, although down from 5 in FY07 to 3 farms currently, are also expected to exceed last year's demands as fields are typically rotated in the spring. FY08 enrollment (to date) provides for the conservation crop rotation of 137.8 acres; a $3,445.00 financial commitment.

Below is a detailed itemization of the FAP Program showing FY07 and FY08 enrollment, acreage, and financial commitment by farm size and practice. The FY08 program information is through December 28th, 2007.

Enrollment (number of farms)	FY07 Cover Crop	FY08* Cover Crop	FY07 Rotation	FY08* Rotation
SFO	10	14	3	2
MFO	7	14	2	1
LFO	2	3	0	0
Total	19	31	5	3

Enrollment (acreage)	FY07 Cover Crop	FY08* Cover Crop	FY07 Rotation	FY08* Rotation
SFO	735	982.5	89.4	128.8
MFO	454.4	1455.2	84.9	9
LFO	208.5	641	0	0
Total	1397.9	3078.7	174.3	137.8

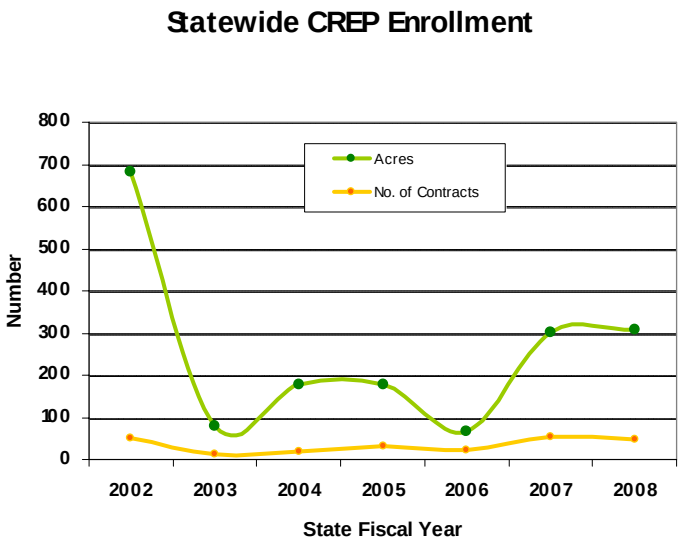
Financial Commitment	FY07 Cover Crop	FY08* Cover Crop	FY07 Rotation	FY08* Rotation
SFO	$14,699.20	$19,650.00	$2,235.00	$3,220.00
MFO	$9,088.00	$29,104.80	$2,122.50	$225.00
LFO	$4,169.40	$12,820.00	$0.00	$0.00
Total	$27,956.60	$61,574.80	$4,357.50	$3,445.00

**Year to date: December 28th, 2007*

Conservation Reserve Enhancement Program

This field floods annually and had been planted to continuous corn. It has since been enrolled into CREP for 30 years, keeping nutrients, sediment, and herbicides out of the stream.

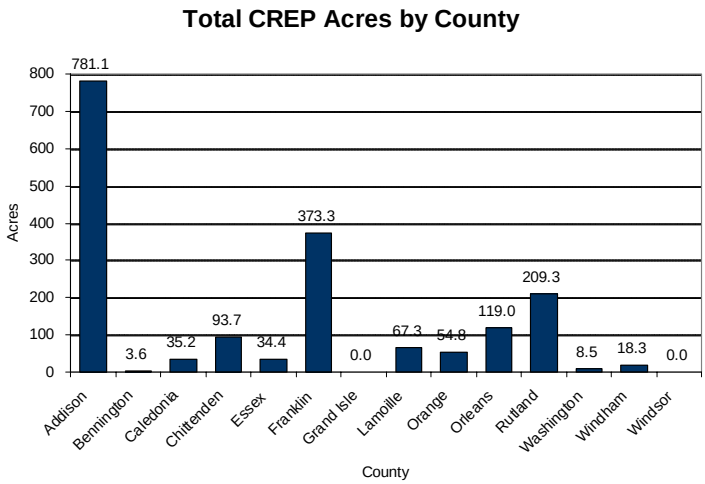
The goal of the Conservation Reserve Enhancement Program (CREP) is to encourage agricultural landowners to voluntarily install conservation buffers. These buffers are designed to treat the farm field runoff and protect adjacent waterways from sediment, phosphorus, nitrogen, bacteria, and pesticides among other things that flow in surface and shallow groundwater. Floodplains are highly productive agricultural lands, hence the reason they are often farmed intensively. In order to reasonably expect the farming community not to farm the land adjacent to streams, CREP has been established to provide compensation for planting these buffers. CREP covers the costs associated with planting the buffer, installing practices such as fencing and watering that may be needed when livestock are present, and provides a rental payment for the land while it is under contract. The rental and incentive payments paid in the program were established to cover the cost of lost production. Contracts can be for 15 or 30 years and a buffer can be comprised of either trees and/or grasses. The minimum buffer distance is 25 feet for grass and 35 feet for trees, and the expected P reduction from surface runoff is roughly 75%.

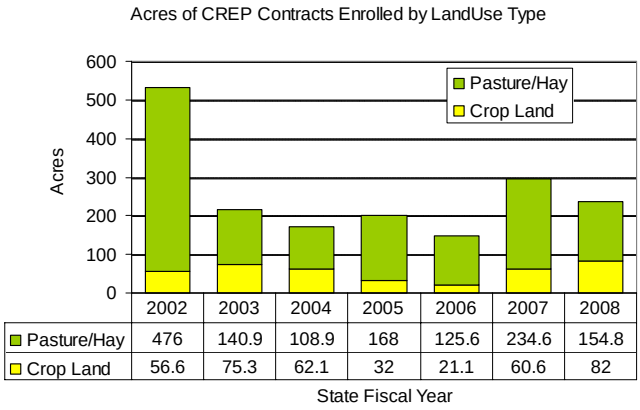


Program Accomplishments

To date, CREP enrollment has reached 1,798.5 acres, which can be estimated to cover nearly 300 miles of streambank assuming average buffer widths. The state has spent $1,133,406 which is matched 4:1 with Federal funds from the USDA Commodity Credit Corporation. Enrollment in 2007 showed an increase in the past enrollment since 2003, and even though 2008 just began, its already on track to be greater than 2007. Enrollment in 2002 was abnormally high due to a backlog of participants waiting for the program to become available.

Addison county is still the area with the most CREP contracts, however Franklin county is number two. Franklin county is on track to be the top producing county in 2008 as sixteen contracts have already been completed, which is the maximum number of contracts Addison county enrolled in 2007. Despite a slow increase in enrollment in the northern Lake Champlain watersheds and the political and financial interests dedicated to the region, there is currently a waiting list of interested applicants. Several meetings have been held to figure out how to handle the backlog of individuals and the NRCS and the Agency of Agriculture have committeed additional staff time specifically in this region which is expected to continue. This is a true testament of the time and energy all the interested parties in the watershed have contributed to educating landowners on the water quality concerns and the benefits that can be received by enrolling in CREP.





	2002	2003	2004	2005	2006	2007	2008
Pasture/Hay	476	140.9	108.9	168	125.6	234.6	154.8
Crop Land	56.6	75.3	62.1	32	21.1	60.6	82

The most popular landuse type enrolled in CREP includes pasture and permanent hayland with more than 1,400 acres. Crop land enrollment is more difficult as there is a limited amount of good crop land in Vermont. Despite this known difficulty however, crop land enrollment in 2007 was up 7% compared to 2006. In 2008 the crop land enrollment is already up to 35% of the total acres, which is a promising sign that crop land rates that were revised in 2006 were sufficient to enlist more crop land. The soil rental rate changes occurred in 2006 through a lengthy process which created a lull in enrollment as rates nearly doubled in value and thus participants were advised to hold off on enrollment until the changes were made, subsequently this also explains the peak in 2007.

The grassed waterway practice was used for the first time in 2007. The summertime floods that occurred in 2006 spawned the CREP committee to review the use of this practice for flood chutes, which are areas where a great deal of soil and phosphorus can be relased into surface waters from crop land. This is an unconvential use of the practice, however thorugh teamwork the group made great strides in helping to reduce agricultural runoff issues during high flow events. Of the areas planned into the program, most are annual or historical flood chute areas that a persistent problems for soil loss and hence landowners have been very open to the idea of planting permanent non-harvestable grasses in these areas.

Vermont Agricultural Buffer Program

The Agency of Agriculture was granted the authority in 2006 to begin a new conservation practice program called the Vermont Agricultural Buffer Program. The goal of this program is to plant harvestable grass buffers on crop land to help remove nutrients through the uptake of the grasses, and reduce the amount of feed that might otherwise be brought onto the farm. To date this program has not been very popular due to the reduced payments compared to CREP, with only the state funding it, it is not as lucrative as CREP to the participant. Secondly, the USDA cannot offer blanket approval that land enrolled in the Vermont Agricultural Buffer Program will be eligible for CREP and the VABP program is limited to five years which is relatively short term and could limit a landowner's conservation options in the near future.

Appendix C: Summary of Existing Wastewater Treatment Practices by Facility Type

At wastewater treatment facilities within the Lake Champlain basin that are currently required to remove phosphorus:

- Chemical addition for phosphorus precipitation is now practiced on a permanent basis at 37 plants, including 32 non-lagoon plants and five lagoon plants. Chemical addition is now required at two more lagoon plants (Proctor and Waterbury), and at one plant that will be converted from lagoon to non-lagoon (Troy/Jay), all in response to the TMDL.
- Biological phosphorus removal by SBR (sequencing batch reactor) is now practiced at 11 non-lagoon plants and proposed at one more non-lagoon plant (Morrisville) and at one plant that will be converted from lagoon to non-lagoon (Troy/Jay). Both proposed SBR upgrades are driven by plant expansion under existing TMDL phosphorus allocations.
- Biological phosphorus removal by anaerobic selector zone is now practiced at five non-lagoon plants and proposed at one more non-lagoon plant (South Burlington/ Airport Parkway) to be expanded.
- Granular media filtration is now practiced at four plants, including three non-lagoon plants and one lagoon plant. There are no current proposals for granular mediation filtration at additional plants.
- Cloth disk filtration is now practiced at six plants, including five non-lagoon plants and one lagoon plant. Disk filtration is also proposed at one more non-lagoon plant (South Burlington/ Airport Parkway) and at one plant that will be converted from lagoon to non-lagoon (Troy/Jay), to accommodate plant expansion under existing TMDL phosphorus allocations.
- Microfiltration is practiced at Cabot only.
- Solids contact clarification by ClariCone is practiced at Stowe only.
- Phosphorus removal by land application and hay harvesting is practiced at Alburg, a lagoon plant.
- Subsurface treatment prior to surface discharge is practiced at Brown Ledge Camp.
- Shoreham practices biological treatment by recirculating gravel filter, prior to surface discharge. Shoreham was a new discharge without a phosphorus allocation. Under state law, Shoreham developed an offsite nonpoint phosphorus mitigation plan to compensate for the new treatment plant discharge to surface water.
- An experimental lagoon anaerobic zone was recently completed at the Hardwick plant. The anaerobic zone is expected to expedite removal of suspended solids and organic content, but testing will be needed to determine whether it will also promote biological phosphorus removal. This technology has been used successfully elsewhere for organics removal, but not for phosphorus removal.

Two Champlain basin plants have phosphorus allocations equivalent to 4 mg/L and 4.12 mg/L at full capacity, meaning that chemical addition is not required:

- Biological phosphorus removal by SBR is practiced at Plainfield.
- Biological phosphorus removal by Sequox, a proprietary modification of the SBR process, is practiced at Pittsford.

A total of 41 Champlain basin plants, 35 non-lagoon and six lagoon, now have facilities intended or applicable for phosphorus removal. All but four of those plants practice chemical addition. Twenty-three (23) of the plants now practicing chemical addition also incorporate some other phosphorus removal technology. This information is summarized in tables that follow.

Wastewater Treatment Plant Facilities Requiring Capital Investment to Comply with Act 43

Facility	Lake Segment	Phosphorus Removal Technology Currently in Place or in Planning as required (in parentheses)	New or Upgraded Filters and/or Chemical Addition Needed for Act 43 Compliance?[1]	Estimated Total Capital Cost[2] (in 2008 Dollars)	Flow Limits[3] (mgd)
Rutland City	04 Otter Creek	Chemical	Yes, filters needed	3,500,000	6.800
Burlington Main	07 Burlington Bay	Chemical + Selector	Yes, filters needed	5,000,000	5.300
Barre City	05 Main Lake	Chemical	Yes, filters needed	3,700,000	4.000
St. Albans City	11 St. Albans Bay	Chemical + Gran Media Filter	Yes, filter upgrade needed	2,400,000	4.000
Montpelier	05 Main Lake	Chemical	Yes, filters needed	4,400,000	3.970
Essex Junction	05 Main Lake	Chemical + Gran Media Filter	Yes, filter upgrade needed	1,300,000	3.100
Middlebury	04 Otter Creek	Chemical + SBR	Yes, filters needed	2,400,000	2.200
Burlington North	05 Main Lake	Chemical	Yes, filters needed	2,900,000	2.000
Winooski	05 Main Lake	Chemical	Yes, filters needed	1,800,000	1.400
Burlington East	05 Main Lake	Chemical	Yes, filters needed	2,400,000	1.200
Milton	09 Malletts Bay	Chemical + SBR	Yes, filters needed	1,900,000	1.000
Northfield	05 Main Lake	Chemical + SBR	Yes, filters needed	1,700,000	1.000
Swanton	12 Missisquoi Bay	Chemical	Yes, filters needed	2,100,000	0.900
Brandon	04 Otter Creek	Chemical	Yes, filters needed	2,300,000	0.700
Morrisville	09 Malletts Bay	Chemical (+ SBR)	Yes, filters needed	1,900,000	0.550
Waterbury	05 Main Lake	(Chemical Lagoon)	Yes, filters needed	1,100,000	0.510
Fair Haven	01 South Lake B	Chemical + Selector	Yes, filters needed	1,600,000	0.500
Poultney	01 South Lake B	Chemical + SBR	Yes, filters needed	1,700,000	0.500
Castleton	01 South Lake B	Chemical + SBR	Yes, filters needed	2,400,000	0.480
Enosburg Falls	12 Missisquoi Bay	Chemical + Selector	Yes, filters needed	2,100,000	0.450
West Rutland	04 Otter Creek	Chemical + SBR	Yes, filters needed	2,400,000	0.450
Richford	12 Missisquoi Bay	Chemical Lagoon	Yes, filters needed	900,000	0.380
Hardwick	09 Malletts Bay	Chemical Lagoon + Lagoon Anaerobic	Yes, filters needed	800,000	0.371
Proctor	04 Otter Creek	(Chemical Lagoon)	Yes, filters needed	1,000,000	0.325
Johnson	09 Malletts Bay	Chemical + SBR	Yes, filters needed	2,100,000	0.270
Hinesburg	06 Shelburne Bay	Chemical Lagoon	Yes, filters needed	1,400,000	0.250
Williamstown[4]	05 Main Lake		Yes, chem. addition needed	500,000	0.150
Plainfield[4]	05 Main Lake	SBR	Yes, chem. addition needed	500,000	0.125
Wallingford[4]	04 Otter Creek		Yes, chem. addition needed	500,000	0.120
North Troy[4]	12 Missisquoi Bay		Yes, chem. addition needed	500,000	0.110
Total Cost, All Plants Requiring Upgrades				***$59,200,000***	

1: Upgrades that would be necessary to bring concentration to 0.2 mg/L. This would not be required for facilities under 100,000 gpd.
2: Does not include the optional selector zone upgrade which typically improves plant performance and reduces the plan operating cost.
3: Includes currently planned expansions (pending final approval by voters and the State).
4: Currently facilities with design flows less than 200,000 gpd are exempt from additional phosphorus treatment requirements, with the exception of new discharges. Upgrading these facilities (with design flows between 100,000 and 200,000 gpd) with chemical addition would be required to necessary in order to meet the 2006 cap required by Act 43

Wastewater Treatment Plant Facilities NOT Requiring Capital Investment to Comply with Act 43

Facility	Lake Segment	*Phosphorus Removal Technology Currently in Place or in Planning as required (in parentheses)*	*New or Upgraded Filters and/or Chemical Addition Needed for Act 43 Compliance?*[1]	*Estimated Total Capital Cost*[2] *(in 2008 Dollars)*	*Flow Limits*[3] *(mgd)*
Weed Fish Culture Station	05 Main Lake	Chemical	No, existing phosphorus removal in place	0	11.500
IBM	05 Main Lake	Chemical + SBR	No, achieving 0.2 mg/l TP from clarifiers, w/ polymer change.	0	8.000
Pittsford Fish Culture Station	04 Otter Creek		No, filters not needed	0	5.000
South Burlington Airport Parkway	05 Main Lake	Chemical (+ Selector + Disk Filter)	No, expansion underway	0	3.300
Rock Tenn	12 Missisquoi Bay	Chemical	No, operating far below permitted flow.	0	2.500
Salisbury Fish Culture Station	04 Otter Creek		No, filters not needed	0	1.310
South Burlington Bart. Bay	06 Shelburne Bay	Chemical + Selector + Disk Filter	No, existing disk filters	0	1.250
Stowe	05 Main Lake	Chemical + SBR + ClariCone + Disk Filter	No, existing disk filters	0	1.000
Troy/Jay	12 Missisquoi Bay	(Chemical + SBR + Disk Filter)	No, expansion underway	0	0.800
Vergennes	04 Otter Creek	Chemical + Disk Filter	No, existing disk filters	0	0.750
Shelburne #2	06 Shelburne Bay	Chemical + SBR + Disk Filter	No, existing disk filters	0	0.660
Shelburne #1	06 Shelburne Bay	Chemical + SBR + Disk Filter	No, existing disk filters	0	0.440
PBM Nutritionals (f/k/a Wyeth)	09 Malletts Bay	Chemical + Gran Media Filter	No, existing filters	0	0.425
Richmond	05 Main Lake	Chemical + Selector + Disk Filter	No, existing disk filters	0	0.222
Alburg	13 Isle LaMotte	Land Application	No, land application	0	0.130
Burlington Electric	05 Main Lake		No, filters not needed	0	0.125
Pittsford	04 Otter Creek	Sequox	No, under 100,000 gpd	0	0.085
Fairfax	09 Malletts Bay		No, under 100,000 gpd	0	0.078
Jeffersonville	09 Malletts Bay		No, under 100,000 gpd	0	0.077
Sheldon Springs	12 Missisquoi Bay		No, under 100,000 gpd	0	0.054
Cabot	05 Main Lake	Chemical + Microfiltration	No, existing membrane bioreactor	0	0.050
Marshfield	05 Main Lake		No, under 100,000 gpd	0	0.045
Newport Center	12 Missisquoi Bay		No, under 100,000 gpd	0	0.042
Northwest State Correctional	11 St. Albans Bay	Chemical + Gran Media Filter	No, existing phosphorus removal in place	0	0.040
West Pawlet	01 South Lake B		No, under 100,000 gpd	0	0.040
Shoreham	04 Otter Creek	Offsite Mitigation	No, offsite phosphorus offset	0	0.035
Orwell	02 South Lake A		No, under 100,000 gpd	0	0.033
Otter Valley Union High School	04 Otter Creek		No, under 100,000 gpd	0	0.025
Benson	01 South Lake B		No, under 100,000 gpd	0	0.018
Brown Ledge Camp	09 Malletts Bay	Subsurface Treatment	No, under 100,000 gpd	0	0.011

1: Upgrades that would ne necessary to bring concentration to 0.2 mg/L. This would not be required for facilities under 100, 000 gpd

2: Does not include the optional selector zone upgrade which typically improves plant performance and reduces the plan operating cost.

3: Includes currently planned expansions (pending final approval by voters and the State)